THE

ELECTRICAL REVIEW.

VOL. LXXIII. SEPTEMBER 12, 1913. No. 1,868.

ELECTRICAL REVIEW.

Vol. LXXIII.] CONTENTS: September 12, 1913. [No. 1,868.

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THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGREKAY, LONDON." Code, A B C.

Telephone Nos.: Holborn 933; Central 4125 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, 19s. 6d.; Canada, £1 1s. 8d. ($5.30). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND, N.Z.: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 16, Palmerston Buildings, Queen Street.
BERLIN: Asher & Co., Unter den Linden; Speyer & Peters, Unter den Linden 43, N.W. 7.
BRISBANE: Gordon & Gotch, Queen St.
CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.
DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.
JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.
LAUNCESTON: Gordon & Gotch, Cimitiere Street.
MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1° 307.
SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1913 EDITION.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

CONTINUITY.

RARELY have we been privileged to read so remarkable and interesting an address as that which was delivered before the British Association by the President, Sir Oliver Lodge, on Wednesday. Traversing the whole field of physical science, and analysing with masterly skill the tendencies ruling in each department, the author presents to the reader a picture, or rather a panorama, of the scene as it appears to himself. We advance so rapidly nowadays, in so many different directions, that it is difficult for the ordinary man even to keep in touch with all the developments which are taking place, and impossible for him to be familiar with them all: we are, therefore, grateful to Sir Oliver for the glimpse which he gives us of the fundamental characteristics of modern scientific thought and labour, for indicating the directions in which they are moving and working, and defining in the clearest language, comprehensible to the plain man, the great questions which are now absorbing the attention of the leaders of the world of science.

So wide a range is covered by the address, and so broad is the author's view, that we cannot attempt to provide our readers with a report of its contents which would do anything like justice to its merits in the space at our command. We shall merely indicate, therefore, the main lines of the address.

The characteristic of the period, says Sir Oliver, is "Rapid progress, combined with fundamental scepticism." Looking back to the latter part of last century, he reminds us that it was then believed that there was little scope for any further great discoveries in physics, and that all that remained to be done was to polish away the imperfections of the science. But there came a succession of startling developments—"the realisation of predicted ether waves in 1888, the discovery of X-rays in 1895, spontaneous radio-activity in 1896, and the isolation of the electron in 1898"—all, be it noted, in the electrical field—and the pace has never slackened since then.

So much for the question of progress. The scepticism to which the author refers is not the old-fashioned theological type, but a philosophic scepticism, the presence of which is manifest at the root of controversies dominating all departments of scientific thought, and which results in a mistrust of purely intellectual processes and a recognition of the limited scope of science.

"Philosophers have begun to question some of the larger generalisations of science, and to ask whether in the effort to be universal and comprehensive we have not extended our laboratory inductions too far." Ancient postulates are being pulled up by the roots; the universal truth of even the sacred Law of Conservation of Energy is called in question, the permanent validity of the Newtonian laws of motion is audaciously doubted!

Sir Oliver, however, stands fast by Newton; his laws need not be discarded—but they must be supplemented in the light of further knowledge. The scientific scepticism is the fruit of the more exact knowledge which is now available—the simple laws of mechanics and physics "are still true as far as they go, their inaccuracy being only detected by further real discovery . . . the law is not really disobeyed, but is modified through the action of a known additional cause."

This brings the author to the subject of his address; for he regards the present phase of physical controversy as a fight between Continuity and Discontinuity, the outcome of which is in doubt. "On the surface of nature at first we see discontinuity; objects detached and countable. Then we realise the air and other media, and so emphasise

continuity and flowing quantities. Then we detect atoms and numerical properties, and discontinuity once more makes its appearance. Then we invent the ether and are impressed with continuity again. But this is not likely to be the end; and what the ultimate end will be, or whether there is an ultimate end, is a question difficult to answer."

"Electricity itself—*i.e.*, electric charge—strangely enough has proved itself to be atomic. There is a natural unit of electric charge, as suspected by Faraday and Maxwell. . . . . Even magnetism has been suspected of being atomic."

The author declares himself an upholder of *ultimate* Continuity, and a fervent believer in the ether of space, the universal connecting medium which binds the universe together, the vehicle of transmission of all manner of force, from gravitation down to cohesion and chemical affinity. Its density "must be far greater than that of any form of matter, millions of times denser than lead or platinum. Yet matter moves through it with perfect freedom, without any friction or viscosity. There is nothing paradoxical in this: viscosity is not a function of density; the two are not necessarily connected. . . . Certain it is that the ether exhibits no trace of viscosity." Even energy has been supposed atomic; Prof. Planck's theory of the *quantum*, or indivisible atom of energy, has excited great interest, and in many respects shows remarkable agreement with the observed facts. If the Principle of Relativity is established, it seems that even *time* will become discontinuous, and the ether must go! But the author advocates a conservative attitude in these matters, and urges moderation in the uprooting of ancient landmarks, especially that of Continuity.

It is exceedingly difficult to make experiments on the ether; motion of matter with respect to the ether has never been observed, the great obstacle being that in every case the ether itself is the vehicle of comparison, so that the effects cancel out. The modern electrical theory of matter —the great new theory of the 20th century—indicates that every material interaction is electrical, *i.e.*, etherial, whence arises the difficulty. There is, however, one hope; the velocity of light in space is independent of that of the source, and by this means it may yet be possible to observe relative motion between matter and ether.

Science, says the author, is incompetent to make comprehensive denials, even about the ether, and goes wrong when it makes the attempt. Each class of scientific worker deals only with a compartment of science—chemists ignore the ether, physicists take no notice of live things, biologists exclude mind and design from their studies. "Hence it is that Science has no authority in denials. To deny effectively needs much more comprehensive knowledge than to assert." A living thing obeys the laws of physics, like everything else—but life introduces something incalculable and purposeful amid the laws of physics, and thus supplements those laws. But although Life and Mind may be excluded from Physiology, they are not excluded from Science, any more than is the ether, though the latter also makes no appeal to the senses. The extreme school of biologists hold that there is nothing but Chemistry and Physics at work anywhere; but they could not account for the existence of such a thing as Beauty by these means—there must be something more. Our studies do not exhaust the universe. To deny the existence of any other region than that of the material world because we are incapable of appreciating it, is to stray from our legitimate province. Evolution is not an illusion; neither is the course of events preordained and inexorable. "Science may not be able to reveal human destiny, but it certainly should not obscure it." With these words Sir Oliver claims for the scientific study of Psychology a fair field; he believes that the Psychic region is amenable to law like other things, and he boldly states that the facts already examined have convinced him "that memory and affection are not limited to that association with matter by which alone they can manifest themselves here and now, and that personality persists beyond bodily death." Moreover, the methods of science are not the only means of arriving at truth. "Genuine religion has its roots deep down in the heart of humanity, and in the reality of things"; as in the case of the ether, "the actions of the Deity make no appeal to any special sense . . . . we are deaf and blind, therefore, to the immanent Grandeur around us, unless we have insight enough to appreciate the Whole, and to recognise in the woven fabric of existence, flowing steadily from the loom in an infinite progress towards perfection, the ever-growing garment of a transcendent God."

Rubber.

WHILE there has at times been a somewhat better tendency in the market for rubber, it would probably be premature to assume that prices have yet reached the very bottom of the slope down which they have been slipping for so long. The production from the plantations in the Middle East proceeds apace, and the prospects point to a continued and rather important increase of output from there during the next few years, when what at present are immature trees get into the productive stage. Meantime, however, undue pessimism should not be entertained on the score of the Mid-Eastern potentialities, because rubber has sunk to a price at which the pursuit of the wild industry has, in very many cases, become unprofitable, added to which there is already a serious reduction in the supplies of certain of the wild rubbers, such, for instance, as guayule. Not only has the destruction of the plant by collectors in this case been a factor making for decreased production, but there has been the revolution in Mexico to reckon with, and this has been no slight hindrance to industrial operations generally in that much-disturbed land.

With occasional fluctuations, the broad course of prices of rubber has been downwards. At the auctions occasional spasms of firmness have been seen, but over a period prices are lower. The hard Para market continues to be more or less controlled, and this is, of course, an unhealthy feature, for an artificial element has been introduced, which at any time may result in undue depreciation following unwarranted inflation. There is certainly no sane reason, on the merits of the two grades, why plantation rubber should stand at a big discount compared with hard Para. The former is admittedly the better value, but there are still manufacturers who prefer, probably from old association's sake, to use the latter, even at a small premium. It is generally admitted, however, that the relative prices of the two are out of harmony. There is another point too. Fine hard Para is put on the market and reaches consumers in a very rough condition, while the plantation manager of the Middle East turns out his material in a variety of prepared forms, the processes involved in which necessitate the expenditure of much time (which means money), and it is quite a question whether this elaborate process of working up the raw rubber, which is adopted on the plantations, is worth while, from the point of view either of the plantation owner or of the consumer. On the face of it there appears to be no valid reason why, in the one case, the roughest methods of preparation should suffice, while, in the other, the most elaborate treatment should be given.

It is not as if there were any difference between the latex from plantation Para trees and that from wild trees of the same species, for there is not. It has been suggested that the plantation manager would be doing better for his employers if he abandoned all the present elaborate preparation of rubber into sheets, biscuits, and so on, and instead graded only into rubber from trees of less than eight years' growth and rubber from trees of eight years and over. The young trees yield poor latex, and the admixture of the latex from all the trees on an estate regardless of age, which is the custom, produces certain irregularities of quality. When all the supplies coming from various plantations are considered, this leads necessarily to uncertainty as to the actual quality of parcels offered. A change in this respect, tending to greater uniformity, would do a good deal to improve the reputation of plantation rubber in the eyes of consumers at large.

The offerings at this week's auctions were on a more limited scale, considerable sales having been recently effected privately, which thus reduced the total available. Prices showed an initial reduction of from ½d. to 1d. a lb. where crêpes were concerned, whereas the demand for smoked sheets was sufficiently good to cause values to be maintained at the level last established.

LEST WE FORGET!

The Aisgill Disaster, and Others.

Lest we forget! Oh! that we could forget Aisgill! Oh! that we might for once shirk our duty and refrain from again perusing the ghastly details of one of the most heart-rending and pitiful of the avoidable catastrophes which have blackened the pages of British railway history. That we might wake up to find it to have been a distressing nightmare! That we might close the book and say: "What a very sensational piece of holiday fiction"! But it cannot be. We have only to turn to our daily papers of a few days ago to find such passages as these:—

Helen Slanders Patterson said her husband was a passenger on the train. She identified a gold watch and other articles produced, but could not identify the remains.

Mary Buchanan Fargie identified certain articles as belonging to her sister, but could not identify the remains.

Alexander Trail identified a brooch with a photo inside as that of his daughter Rebecca. He identified the remains in pile "No. 4" by a piece of chain belonging to a pendant worn by his daughter, clinging to the back of the neck.

As Mrs. Patterson and the witnesses who followed gave evidence, an official produced a little brown paper and laid the contents on the Coroner's table—little scraps of metal that had been through the fire, all that remained recognisable of those who had met their death in the blazing wreck. More than anything else these pathetic relics brought home to one the horrors of that funeral pyre that shamed the tardy dawn on the lonely moor, and one could picture the scene as never before.

The horror of it! Suppose it had been our daughter, son, wife, or parent that was represented by that charred heap "No. 4"!

Our deepest sympathy goes out towards those bereaved relatives who have lost kith and kin in such harrowing circumstances. To lose a friend or a relative is ever a sad experience, but to gaze upon a mangled and charred pile and say: "Alas! that must have been my daughter, I recognise her locket"; or, "Poor boy, that watch, which is all I can recognise, was my last birthday present to you," is an experience the haunting memory of which time can never blot out. So far as is known the death roll of the disaster is 16, two persons having since the accident succumbed to injuries received. The following is the list of the first 14 victims handed in by the doctors at the inquest, and represents the "piles" of which "No. 4" has been already referred to:—

1. Adult female.
2. Uncertain as to sex; probably female.
3. Adult female.
4. Adult female.
5. Probably male child.
6. Child; sex uncertain.
7. Adult male; pieces of gold found in back.
8. Adult female.
9. Portion of child; probably female.
10. Adult female; large woman.
11. Female child; probably portion of No. 9.
12. Adult male.
13. Remains of young person; sex uncertain.
14. Young female.

Each of those unrecognisable piles represented what a few hours before was a human being. Sombebody's son—somebody's daughter! Would that we *could* forget.

But what of the cause, and was it preventible? These are serious questions to which the British public demand, and will continue to demand, an answer. It is not for us to anticipate the findings either of the Board of Trade Inspector or of the Coroner's jury, but distasteful and unthankful as the task may be, we feel it to be our duty to fix the attention of our readers, and through them of the general public, upon the state of things immediately following the collision, and to remind them once again of similar circumstances in connection with previous railway accidents. Let us turn, then, to the records of the daily Press, which, in commenting on this appalling tragedy, have exhibited an extraordinary unanimity.

Giving his experiences, one passenger said:—

Six men were pulling at a man who was fixed by his middle in the wreckage which was blazing around him.

After five or ten minutes' struggle he was released, his legs being badly burned, his hair burned, and his arms and hands crushed.

I was one of those who were pulling him out, and I heard him say, "Pull, my God! pull." He kept on saying that all the time, and as the wood burned away around him we got him free.

No sooner had this man—who, I believe, has since died—been dragged out than a pair of hands shot out of the side of the carriage amid the flames.

A man standing by rushed to get hold of them, but found that, owing to the heat and the man being pinned down so heavily, it was impossible to get him out.

We could see nothing of his head or body, but only those two hands waving frantically in the flames, and when his rescue was found to be impossible every man turned away in silence. We were all crying.

The flames were lighting up the whole of the landscape round, and there was a crackling and roaring which was awful to hear when we knew that there were people inside the blazing wreck.

From another paper we cull the following, being part of an interview with a passenger who assisted in the work of rescue: "The burning coaches made the work of rescue exceedingly difficult, for they sent out tremendous heat, and rendered it impossible at times for anyone to approach near enough to reach the passengers who were buried." The same passenger said: "The glare of the blazing woodwork of the wrecked carriages lit up the hillside on each hand"; and, referring to a poor woman with swollen eyes who was nursing a baby whose face was badly scarred, he added: "From what I learned it would appear that the other three children whom the woman had in her charge must have been burned to death before the rescuers could get to them." We do not wish unnecessarily to harrow our readers' feelings, but we do want to impress upon them the terrible nature of the scene which followed the collision, for, as a writer in the *Pall Mall Gazette* has truly pointed out, "there is only too much reason to fear that when a week or two have passed, the subject will have passed likewise, and the problem of railway safety will have been abandoned to those whom it professionally concerns."

There is, of course, the possibility that a passenger suffering from the severe shock which such an experience must naturally produce may unintentionally exaggerate the awfulness of the scene; but, against this view, we have the descriptions of eye-witnesses who were not passengers. Thus, a man who lives within 100 yards of the spot where the collision took place was aroused by the noise of the impact, and, on going out, "could discern the flames shooting high above the cutting. Flames were coming from the last three coaches, and it was evident that if anybody was to be saved a miracle would have to happen. There could be no help, for the flames were everywhere roaring like a furnace. The flames scorched all who were near the lines. I saw a couple of bodies removed from somewhere . . . the victims were charred beyond recognition, and the smell of burnt flesh was horrible. . . . It was a terrible sight, and if I live to be 100 I shall never forget it." Although numerous other extracts to a like effect might be given from the descriptions in the daily Press, sufficient has, perhaps, been said to convey an idea of the appalling character of the scene, and again we must put the question: "Is it an essential sequel to a collision between two trains that the coaches should take fire and add to the effects of the collision the unspeakable horrors of burning alive?"

Our readers know what is in our mind. They know that our opinion, which we have not hesitated to express on many an occasion in the past, is that the lighting of trains by compressed oil gas is not only unnecessary, but, in the light of past experience, should not be permitted.

There are some, a small minority, including the officials of the Midland Railway Co., who contend that it was not gas which set fire to the coaches. An official message issued by the general manager of the Midland Railway contained the following passages:—

The fire was confined to the three last coaches of the first train, and was started by the fire scattered from the engine of the second train in collision.

The doctors who made a post-mortem examination have given us authority to say that in their opinion there is no doubt that those passengers who lost their lives were instantly killed by the collision.

We fail entirely to reconcile the latter portion of this statement with the list of 14 victims handed in by the doctors at the inquest. As already indicated above, the remains of these 14 victims consisted of almost unrecognisable heaps of charred material, so charred that in five cases out of 14 the sex was uncertain, and in practically all cases the identity

was only established by means of metal trinkets which had belonged to the victims. In the face of such gruesome facts, how can we be expected to believe that death was in every case instantaneous and due to the collision only? We have only to refer to the remarks of the Coroner at the inquest on Sir Arthur Douglas: "He was only rescued in the teeth of the flames after the protracted efforts of a band of rescuers." . . . . "The very serious injuries he received, probably from the fire mainly, had resulted in his death." And what of the accounts of eye-witnesses quoted above? The first statement, viz., that the fire was started by the fire scattered from the second engine, is equally incredible, and the evidence given by the driver of that engine (see our "Notes" pages) negatives the suggestion.

Even supposing that ashes or cinders were scattered, a possibility which we do not admit, any one who has ever tried to light a *properly-laid* fire by means of cinders knows that it is by no means an easy task. But what is the evidence on this point?

An eye-witness, who displayed great heroism in the rescue work, told a *Daily Chronicle* representative at Leeds that the fire came from the gas tube underneath the telescoped carriages.

"When I jumped from the carriage just as the shock occurred," he said, "it was blowing like a blast furnace. It was this that undoubtedly caused the fire. It was partially stopped by the firemen, who tapped the pipe with the hammer; but the flame rushed under the carriage, which was thus set on fire, and that impeded the work."

At the inquiry, the following, among other evidence, was given - evidence which directly contradicts the official statement. After stating that fire had started within five minutes of the collision, Driver Nicholson was asked by the Inspector the following direct question: "Was any portion of the fire under the foot-plate of the engine?"

The reply was emphatic. "No, Sir, I am quite certain it was in front of the buffers of the engine." He added that "at the time there was a fire *in the roof* of the carriage."

The fireman (James Metcalfe), who was actually alongside the train near the point of collision when the accident occurred, described the occurrence as follows:—

In reply to a question: "What happened? Did you see a tremendous flash?" he replied:—

No, I did not. The engine appeared to hit the brake van, and this seemed to rise about 3 or 4 ft. There was a flickering of light, as if it was caused by the engine bogie coming off the rails and running along the stones of the ballast.

There was no big flash?—No, sir.

Did you see fire thrown out from the engine firebox?—No, the sparks or light I saw were not caused by ashes.

Then we have the evidence of Arthur Fisher, the sleeping-car attendant:—

The fire he noticed was a few yards in front of the buffer beam of the engine, and seemed to be on a higher level than the floor. He believed the seat of this fire was in the midst of a large quantity of broken baggage and boxes.

The evidence of Donnelly, the guard of the ill-fated train, was corroborative:—

As soon as the collision occurred witness saw one monster flash as if all the gas in the cylinders under the train had become ignited. The flash was succeeded by darkness. The flash lasted only an instant. He added that the flames were high up.

The rear guard's evidence was also to the effect that the fire was burning up *in the roof* of the train.

No doubt the evidence of those passengers who have given their accounts to the Press will be taken later, but sufficient has already been published to establish beyond cavil the origin of the fire.

But, *lest we forget*, let us turn to the records of previous disasters. One need not search outside the files of the Electrical Review for evidence enough to convict any railway company of utter disregard to the safety of their passengers in persisting in the use of compressed gas lighting. From our issue of March 9th, 1906, we extract the following: "The report of Lieut.-Col. von Donop on the accident in Catesby Tunnel, on the Great Central Railway, makes interesting reading for electrical men. Three of the coaches were lighted with gas; when the train was derailed, the gas went out in every instance, and began to escape freely. Had any one struck a match and caused an explosion, what a horrible disaster would have ensued! Of the two electrically lighted coaches, one was put in darkness, but the other remained lighted, and its light was invaluable in facilitating the work of rescue. But alight or not, there was no danger from electricity. Needless to say, the Inspector strongly urges the use of electricity in preference to gas for lighting trains."

Here, then, we have a recommendation by a Board of Trade Inspector over seven years ago. Has it been acted upon? Nor was this the first occasion on which this Inspector had called attention to the dangers of gas lighting. In December, 1905, reporting on the accident at Witham, G.E.R., in which 10 persons were killed and 40 injured, Lieut.-Col. von Donop said:—"The gas in the cylinder of a first-class carriage . . . appears to have been ignited. The occurrence points to the desirability of adopting some other form of illumination, probably electricity." Again, in reporting on the Grantham disaster on the G.N.R. in September, 1906, this Inspector reiterated his remarks as to "the unsuitability of gas as an illuminant for railway vehicles."

In our issue of December 30th, 1910, we referred to the collision which occurred on Christmas Eve at Hawes Junction, not far from the scene of the Aisgill disaster. On this occasion Major Pringle wrote in his report:—

It cannot be denied that compressed oil gas, stored in the cylinders under the two first coaches, was the origin of the fire. Nor can it be denied that there is greater liability to fire in a railway accident of this description when gas is used as the illuminant than with electric light. With every possible precaution it will remain true that electric lighting will still be the safer method. On grounds of safety, therefore, I still hold electricity is the more desirable means of illumination for passenger trains, and, as such, should be adopted wherever possible. In the case of long-distance and express trains it is more particularly to be recommended.

We and the general public want to know what steps have since been taken by the railway company to comply with this very definite recommendation, and what steps, if any, have been taken by the B. of T. to enforce it?

In practically all the recent inquiries into railway accidents the same recommendations have been made. On March 15th, 1912, we gave an extract from Major Pringle's report on the collision which occurred on January 29th, near Saltley, on the Midland Railway. In his report the inspector said: "the escaping gas ignited in some way, difficult to ascertain, and set fire to the floor of the vehicle. . . . . The circumstances clearly point to the desirability of either abandoning the use of gas for lighting purposes, or of making such structural alterations and additions which will lessen the liability of fire arising therefrom."

Our own comment at the time was as follows:—"In our opinion, to strengthen the gas cylinders is mere temporising, the only sure remedy is to root them out, and adopt electric lighting," an opinion which we hold more strongly than ever.

In our issue of September 6th, 1912, we reported two accidents arising from gas-lighted carriages. One was at the Manchester Exchange station, where the gas reservoirs of a train were being charged. The escaping gas became ignited by a lamp carried by an employé, and the explosion which followed injured seven men. The second accident referred to in the same issue occurred in Toronto, and was caused in almost precisely the same way, namely, by the torch of a gas tester setting fire to the gas tank under the car. In our comments on the Manchester accident we said: "So many accidents of one kind or another have been reported in connection with gas-lighted trains, and the safe alternative of electric lighting is so readily to hand, that one begins to suspect Government and railway departments of being alike indifferent as regards the safety of both passengers and employés." So far as the Government is concerned, nothing has since been done to cause us in any way to modify our opinion, but we know that several railway companies are gradually extending the electric system of lighting their carriages without Government compulsion.

Coming to still more recent examples of the gas danger, the accident which occurred at Ditton Junction on the L. and N.W. Railway in September of last year was the subject of our leading article on September 27th, before the official report had taken place. On this occasion we wrote: "The shocking accident which took place at Ditton Junction last week, when a number of unfortunate passengers . . were not merely killed but tortured to death by fire, once more draws attention to the frightful dangers entailed by

the use of gas for lighting and cooking on railway trains. It is not as if there were no alternative; the remedy lies to hand. Electricity is perfectly capable of performing all the functions now fulfilled by gas, with the exception that it cannot be accused of roasting the passengers, and the preference still exhibited by some of the railway companies for the older system is attributable only to a tender regard for the pockets of the shareholders, arising from the belief that a slight economy can be effected by its use." We further commented on the attitude of our contemporary, the *Gas World*, which abused the daily papers because they then, as now, pointed out the wickedness of persisting in using so dangerous a system of lighting; our comment, "to argue that the gas was not to blame, is to fly in the face of reason," was amply vindicated in Sir H. A. Yorke's report, which contains the following significant passage :—

So far as safety is concerned, there can hardly exist in anyone's mind a doubt that electricity is the better, and I think the railway companies would be wise to recognise this fact and adopt electricity as the standard illuminant on all their main-line trains before they are compelled to do so by the pressure of public opinion.

We have referred in detail to the foregoing events, *lest we forget* the repeated warnings which have been given, and we would once again quote from our own pages. In referring on September 27th, 1912, to the Ditton Junction accident, we said :—

"For many years the inspectors of the Board of Trade have consistently urged the desirability of substituting electricity for gas, and have on various occasions definitely attributed fires to the use of gas. But nothing further is done, and the railway companies ignore the recommendations which are not backed up with compulsion. The public sleepily looks on, and the lay Press roundly abuses the companies for three days—then all is quiet until the next horrible disaster."

There are several other points arising out of the disaster under consideration, and we shall refer to these on a future occasion; for the present we want to rivet attention on the question of lighting, and to ask once again—what are the railway companies going to do about it? What is to be the Board of Trade's attitude? Hitherto, as the *Daily Sketch* aptly points out, it has pursued a policy of masterly inactivity, it has pigeon-holed its inspectors' reports, sat tight and done nothing.

If the Home Office has power under an order of the Home Secretary to make and enforce regulations for the safety of workmen in factories, surely the Board of Trade possesses similar powers of making and enforcing regulations for the safety of the travelling public. If not, then the public must not rest until such powers are obtained.

TRAMWAY CURVES.—II.

By A. J. BOUSFIELD, A.M.I.Mech.E.

If a tramway curve has been laid out as a simple arc of a circle, then its life is usually determined by the wear on a certain short part and not by general wear throughout its length. This localised wear will usually occur near the entrance to the curve, its exact position depending on the correctness or otherwise of the superelevation and the gauge.

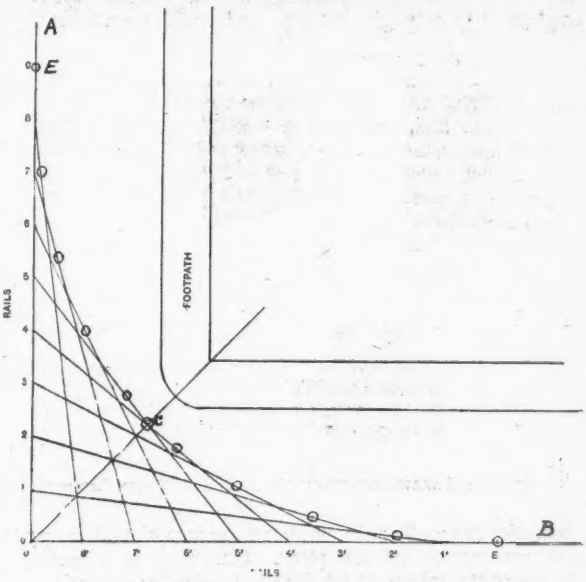
The remedy for this, alluded to in a previous article (Elec. Rev., May 2nd, 1913), is to lay the track as a parabolic curve, the curvature gradually increasing to a maximum about the centre of the curve and then gradually decreasing.

The parabolic curve has this advantage, that the radius of curvature increases as the speed of the car (as controlled by the average motorman) decreases, and decreases as the speed increases. A second great advantage is that the overhang clearances may be made less than is the case with circular curves, where the clearance all round the curve is controlled by that necessary at the ends of the curve where the cars swing most.

Where a true parabolic curve would not be admissible owing to local conditions, a curve may be improved by making it a compound circular curve having two or more radii, the rail being shaped up by the crow to the eye to make a smooth run.

To make a true parabolic curve, the method of procedure is as follows :—

1. By means of tape measurements or scaling off an ordinance map, transfer in chalk the contour of the street corner on to the rail crowing floor (which should be of ample size and finished up level and smooth with cement and painted with tar). This plan may be to scale, but should preferably be full size. Taking first the inner rail, mark in chalk



Setting out a Parabolic Curve.

the line of the straight rail at entry and exit of curve and extend these lines A O and B O until they meet at the point O.

2. Mark with a circle this point of intersection, and drive in a pointed iron pin.

3. Draw a line bisecting the angle A O B, and mark a point C on this line as near the curb as the rails will be allowed.

4. Divide up the line O A into (say) eight parts, marking them 1, 2, 3, 4, 5, 6, 7, 8.

5. Connect two pointed iron pins with a length of good light cord, so that, when stretched, they are a distance apart about equal to O A or O B.

6. Place one of the pins on O A, pass the line round O, and place the other on O B, stretching the line tight, and so that the pins are equi-distant from O; stretch a line tightly between the two pins and note if this second line passes through the point C; if not, adjust the length of the first line so that it does, taking care that the pins are equi-distant from O.

7. Place the pins on point marked 1, pass the line round O, and place the other pin on O B, stretching the line tight; stretch a chalk line between the two pins and mark by plucking.

8. Repeat, using point 2, and so on up to 8.

9. The centre of each of the sides of the portion of irregular polygon formed by the exterior of this construction is a point on the curve required. Place one pin at O and stretch the other to its full length along O A and O B; the two points so marked are the points of exit and entry of the curve. Draw out the curve through these points and paint in with white paint.

10. Mark off on this curve lengths equal to the length of rail to be used. Draw chords and a master chord from A to B for checking purposes.

11. Set up off-sets from these chords, increasing the number of off-sets where the curvature increases.

12. The platelayers can now crow up the rails to these off-sets and make a complete single rail which, when fishplated and bolted up, will be the inside rail of the curve.

13. The one (or three) remaining rails can now be crowed to gauge with this rail as a template, an equal overhang clearance being allowed all round if the track is double.

VICKERS PATENT S.B. SYSTEM OF TRAIN LIGHTING.

One of the most interesting features of the exhibit of Messrs. Vickers, Ltd., at the Ghent Exhibition is their improved system of train lighting by electricity. The firm for many years have made equipments for this purpose on the double-battery system, one battery being charged while the other is being discharged, but the "S.B." system employs only a single battery, and enables considerable economies to be effected in first cost, consumption of energy, and maintenance of the plant. Simplicity is a leading feature of the system, which is also completely automatic.

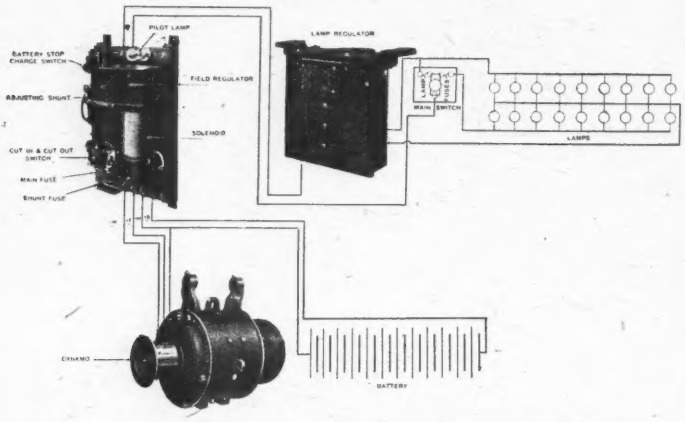


Fig. 1.—Arrangement of Vickers S.B. Train-Lighting System.

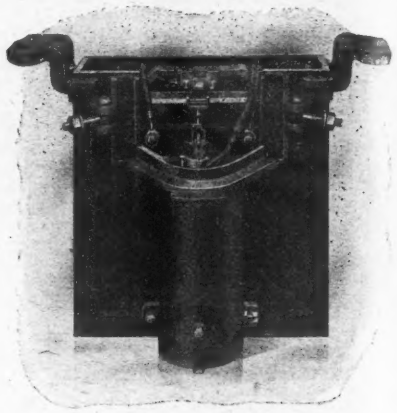


Fig. 3.—Lamp Voltage Regulator.

The general arrangement of the system is shown in the diagram of connections, fig. 1. The principal apparatus are the dynamo, the battery, and two regulators—one controlling the output of the dynamo and the other the voltage applied to the lamps, &c.

The dynamo, shown in fig. 2, is of the simplest form possible, being a plain enclosed shunt-wound machine, without any automatic devices except a movable brush carrier, which is mounted on ball bearings so that the friction of the brushes on the commutator suffices to rock the brushes over against stops in the direction in which the armature is running, thus maintaining the terminal polarity constant, no matter which way the train is running. The dynamo is slung under the carriage underframe or the bogie truck in the usual way, and is driven from one of the axles by a belt, the tension of the latter being maintained partly by the weight of the dynamo and partly by springs. The armature shaft runs in ball bearings, and the whole machine being dust-tight and waterproof, needs practically no attention.

The automatic regulator-controller, which is illustrated in fig. 4, is, so to speak, the brains of the system. Its several parts are indicated on the figure, and the diagram, fig. 5, shows the connections of the whole system. Starting from the dynamo + terminal, the current flows through the main fuse, and the series winding of the automatic switch to the lamps and battery respectively. In the battery circuit is interposed a solenoid, shunted by a diverter resistance (B E), which can be adjusted by varying the position of the contact B. A small branch from the dynamo + terminal, protected by a fuse, supplies three fine-wire windings: one on the automatic switch, which connects the dynamo to the battery when the voltage of the former is sufficiently high; one on a small automatic switch, the "battery stop-charge switch"; and the third on the main regulating solenoid, controlled by the stop-charge switch. The action of the main automatic switch, it will be noted, depends entirely upon the voltage of the dynamo, so that the latter cannot be connected to the battery unless it is excited and ready to charge the battery; hunting is prevented by the use of the series winding, which ensures that the switch will not open until the voltage has fallen to a value considerably below that at which the switch cuts in, and also produces a strong pressure between the switch contacts, increasing with the current.

The regulator solenoid, which is normally excited only by the current passing from the dynamo to the battery, acts upon a core connected to the field regulator, which varies the resistance in circuit with the dynamo field magnets. The construction of this regulator is exceptionally interesting. The steps of the resistance are connected to thin metallic plates sandwiched between layers of insulating material, their upper edges forming a track upon which the regulator contact *rolls*, as shown in fig. 5. The contact maker consists of a bundle of copper laminations, V-shaped in cross-section, with their edges applied to the track; it is mounted in such a way as to have perfect freedom of movement, and is tilted to and fro by the core of the solenoid so as to vary the amount of resistance in circuit by a large

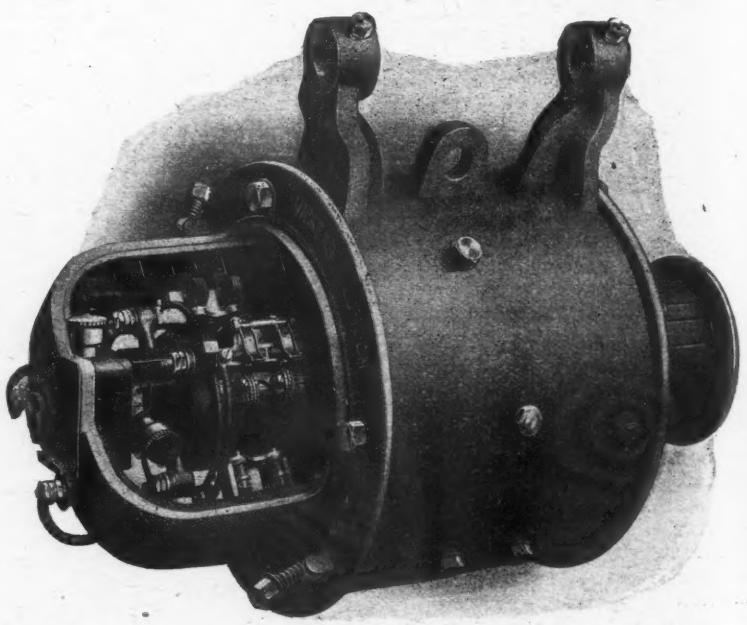


Fig. 2.—Vickers Train-Lighting Dynamo, with Dust Cover Removed.

number of small steps, the roller being connected to the small positive branch from the + terminal mentioned above. The device is the best mechanically operated variable resistance that we have yet met with. To prevent sudden movements, the plunger of the solenoid is provided with an air dash-pot.

The operation of the regulator is controlled by the position of the adjustable contact B, which is clamped upon the spiral wire diverter F E; when B is near E, most of the dynamo current goes through the diverter, while when B is near F a larger proportion passes through the solenoid. As the regulator always acts so as to maintain a constant current in the main winding of the solenoid, the total output of the dynamo to the battery thus depends upon the position of B, which is determined when the apparatus is installed.

Should the battery be charged for so long a period that its voltage rises beyond a predetermined and adjustable limit, the small automatic switch is actuated and closes the circuit through the fine-wire winding on the solenoid, which assists the main winding, and therefore inserts a larger resistance in the dynamo field circuit; this has the effect of reducing the charging current to a few amperes only, and prevents the battery from becoming overcharged.

We now turn to the lighting circuit, which it will be seen is connected to a second travelling contact on the resistance F E, and to the negative terminal common to the dynamo

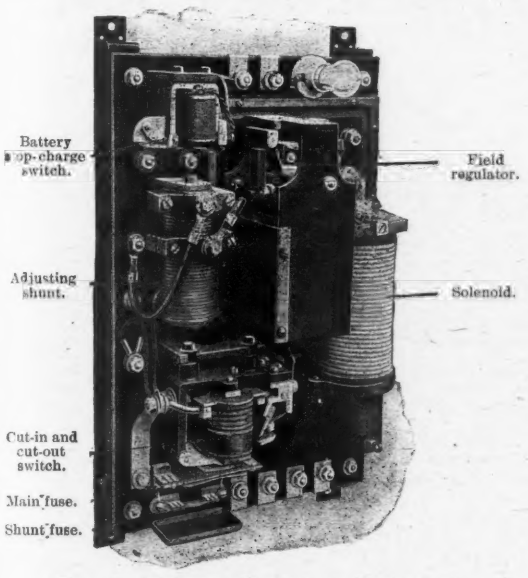


Fig. 4.—Automatic Regulator Controller.

and battery. As the lighting current passes through the same resistance that is used as a diverter for the regulator solenoid, it is evident that a wide range of adjustment is available; with D at E, the whole of the lighting current is derived from the dynamo in addition to the normal charging current; with D against B, the lighting circuit is connected across the battery terminals, and the dynamo output is limited to the ordinary charging current; with D in any position between B and E, intermediate divisions of the load can be obtained, and, as previously explained, the contact B can be moved to regulate the charging current. The minimum dynamo output is obtained by disconnecting A from B.

A separate regulator, fig. 3, is provided for controlling the voltage of the lighting circuits, based on the same principles as the regulator-controller, but with the difference that in this case the actuating solenoid is wound with fine wire and acts so as to maintain the voltage constant by short-circuiting more or less of the resistance, which carries the current going to the lamps. It is stated by the makers that with this device the variation in pressure at the lamp terminals, under ordinary working conditions, is only 1·1 per cent. from the normal.

Both the regulators are enclosed in dust and waterproof cases, suitable for fixing to the underframe of the coach; they can be installed inside the coach if preferred, but in any event they are entirely automatic and need no attention on the part of the train staff. The lamps are divided into two circuits, either or both of which can be switched on with a single switch, but they can, of course, be arranged in any way that may be specified.

The battery is of any suitable type that may be preferred by the user, and consists of 12 cells, the normal voltage of the system being 24 volts. It is carried under the coach in a box.

From the foregoing brief description it will be seen that the system is very simple, and involves the minimum of

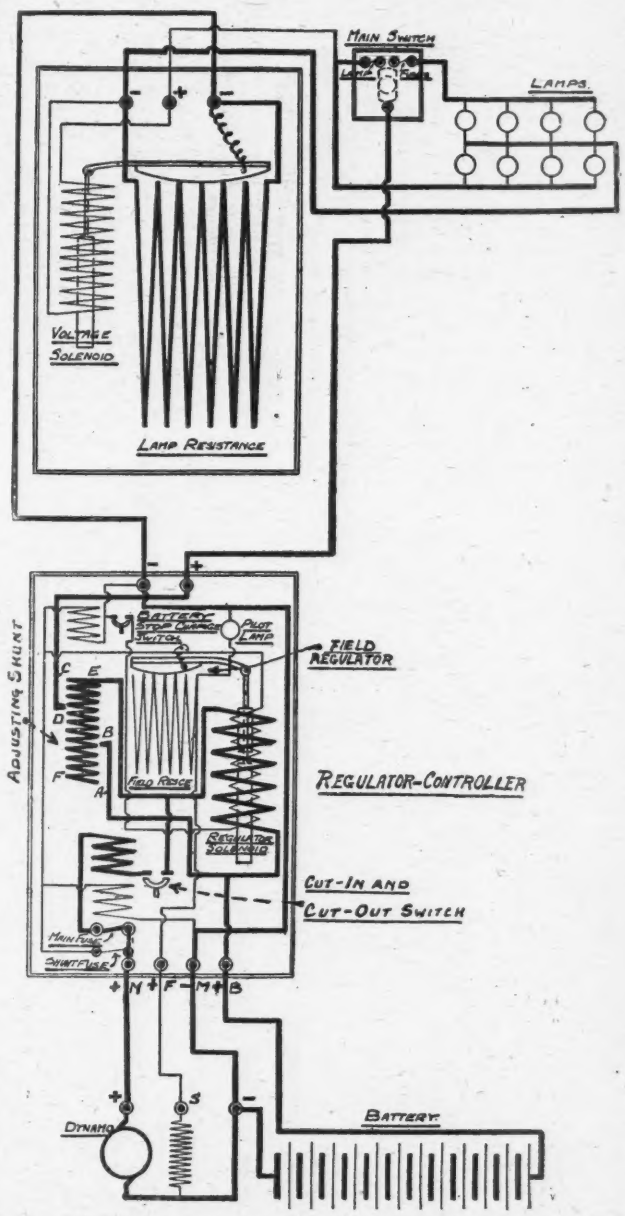


Fig. 5.—Diagram of Connections, Vickers S.B. Train-Lighting System.

apparatus and plant; it is also effective and reliable. The equipment is made in three standard sizes, the output of the dynamo being 25, 50 or 75 amperes, and the battery being of corresponding capacity, but only one size of regulating apparatus is required for all three types.

In view of the close attention which has recently been directed to the subject of train lighting by the tragedy of Aisgill Moor, we think that this, the latest system that has been developed for that purpose, should be of especial interest to our readers. The system is in use on a large number of passenger coaches in this country and abroad; we inspected one of the equipments installed on the Continental trains of the South-Eastern Railway Co., and were very favourably impressed with the design and construction of the apparatus, which appears to possess all the qualities required to ensure satisfactory operation.

ELECTROMETALLURGY OF ZINC.

Among common metals, zinc is that of which the world's consumption has risen most rapidly and uniformly. From 1900 to 1912, this consumption rose from 470,000 to 920,000 tons, and 37 companies in Europe are now engaged in the production of 570,000 tons of zinc per annum, the market value of which exceeds £14,000,000.

Hitherto zinc has been volatilised from its ores by heating charges of from 110 to 220 lb. in banks of small refractory retorts, the whole arrangement representing a multiplication of laboratory apparatus. The retorts absorb a great deal of heat, and each produces—in a discontinuous manner—from 44 to 66 lb. of metal per 24 hours. The furnaces are costly to build and maintain, consume five tons of coal per ton of zinc produced, and permit at least 10 per cent. loss of metal from the ore treated. A large and skilled staff is required, and the foundry must be located near deposits of refractory earth. The continual rise in coal and wages costs absorbs the small economies realised by gradual perfecting of the furnaces and retorts, and shaft furnaces taking several tons of ore and fuel at each charge, are not applicable, since the air necessary for the combustion of the fuel oxidises the zinc.

The electric furnace described below avoids this difficulty while realising the chief advantages of the shaft furnace. It is simple in construction, easy and cheap to maintain and operate, compact yet of high output, expeditious and efficient in action. The loss of metal from the ore is about two-thirds that occurring under the most favourable conditions in Belgian and Silesian retorts.

The capital cost of the equipment per ton of metal produced per 24 hours, is £2,800 for retorts, and £800 for electric furnaces, and the cost of treatment per ton of 50 per cent. ore is :—

	Silesian retorts.	*Electric furnaces.*
Desulphation by roasting ...	£0·40[1]	—
Lime and coal for desulphation	—	£0·48
Heating	0·88[2]	0·68[3]
Labour	0·72[4]	0·32[5]
Maintenance	0·48[6]	0·64[7]
Total	£2·48	£2·12

[1] Paid to H_2SO_4 works for roasting ore. [2] 2 tons coal at 8s. 9d. [3] 120 H.P. for 24 hours at £1 16s. per H.P.-year. [4] Three days at 4s. 9d. [5] Two days at 3s. 2d. [6] Retorts, pipes, furnace repairs. [7] Electrodes, refractory and electrical material.

The corresponding total costs of manufacture per ton of metal are :—£6·72 by the retort, and £6·28 by the electric furnace method ; in the case of 30-35 per cent. ores, the advantage in favour of the electric furnace is still more marked.

The metallurgy of zinc is dominated by the fact that, since about 2 tons of coal is used per ton of 50 per cent. ore reduced in Silesian retorts, the foundry is located as near as possible to collieries. Consequently, the ore has frequently to be transported over long distances ; for instance, there are mines in the Pyrenees from which ore has to be transported by mules and, later, wagons to the nearest port or foundry. With few exceptions, these deposits (at 5,000-6,600 ft. elevation) are very difficult of access and yield only 20 per cent. ore, which must be washed up to 50 per cent. metal content before being placed on the market. To effect this enrichment without leaving more than 15-20 per cent. of the zinc in the tailings, a modern washery plant must be erected capable of handling 100 tons of ore per diem and costing, say, £40,000. If the mine is not sufficiently productive to employ fully such a washery, it may be unprofitable to work it at all unless zinc stands at over £20-£22 per ton. For this reason, France imports over 20,000 tons of zinc per annum instead of exporting this metal.

Where sufficient water power is available to operate hydro-electric stations producing from 3,000 to 4,000 H.P. at £2 or less per H.P.-year, the use of electric furnaces revolutionises the economical situation in poor ore zinc mines.

Referring to fig. 1, the curve A B shows that the cost of electric furnace treatment is higher the poorer the ore, but the cost of washing the ore increases with the concentration required. The intersection O of A B, C D corresponds to the lowest point M on the curve E F representing the cost of both treatments ; this minimum corresponds to a zinc content between 30 per cent. and 35 per cent. The latter figure varies according to the cost of electrical energy but, in any case, a mechanical preparing plant costing about £2,400 would bring the ore up to a zinc content suitable for treatment in electric furnaces.

It is characteristic of the electric furnace that it retains its economic advantages even in small units, so that it would be

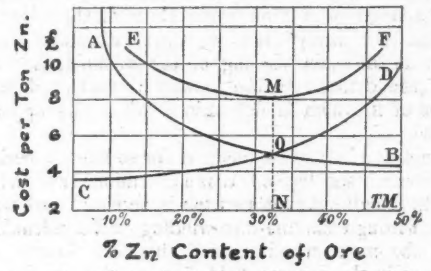


Fig. I.

preferable to erect a number of small electric zinc foundries rather than transport ore by road or mountain railway to a large foundry.

As an example of the economic advantages of electric furnaces, let us assume that a blende mine, 5,600 ft. above sea level, produces 10,000 tons per annum of 16 per cent.-ore and that :—

Case I.—The ore is taken by cableway to a washery, where it is made to yield 2,600 tons of 43 per cent.-ore ; the latter is sold at Antwerp and taken to Bayonne by sea.

Case II.—The raw ore is washed till it yields 3,700 tons of 35 per cent.-ore, which is reduced in an electric foundry costing (complete with three 400-H.P. furnaces, buildings, land, &c.), £12,000.*

Case I.

Extraction, descent, enrichment	£5,600
Transport to Antwerp	3,450
Cost	£9,050
By sale of 2,600 tons ore	10,730
Profit	1,680

If the market value of zinc fell below £20 per ton, this profit would vanish and the mine could not be worked commercially.

Case II.

3,700 tons of 35 per cent.-ore delivered at furnaces ...	£5,410
Energy—1,200 H.P.-years at £1 16s.	2,160
Lime and coal	1,440
Electrodes, furnace maintenance, works' materials, &c. ...	2,080
Labour (at 3s. 7d. per man per day)...	1,080
Management, taxes, insurance, &c.	1,000
	£13,170
Delivery to Havre	1,280
Total	£14,450
Sale of 110 tons zinc at £21	23,100
Profit	8,650

By reducing its ore electrically, the mine would thus secure £8,650 profit, as against £1,680 realised by selling 43 per cent.-ore.

The Côte and Pierron Electric Furnace.—Considering the old method of separating lead by fusion of galena with iron in a shaft furnace, one would expect that the analogous displacement of zinc by fusion of blende with iron in an electric furnace would be industrially successful. However, although the zinc leaves the bed of the furnace as vapour, the water, carbon-dioxide and air inevitably introduced by the ore oxidise the metal, so that "blue" powder is obtained instead of coherent blocks of zinc. The redistillation of this powder is costly, and involves a serious loss of metal. Further, the high temperature required in the zinc furnace severely attacks the refractory lining of the bed.

In 1904, Côte and Pierron first endeavoured to overcome these difficulties by the use of the electric flux,† and the first industrial electric zinc furnaces were installed in a 250-600-H.P.

* For details of this and other composite sums in the estimate, see an article by C. Lordier, "La Technique Moderne," No. 5, 1913, whence these notes are extracted.

† See also Annales de la Soc. d'Agric., Sciences et Ind. de Lyons, Decr., 1908.

plant at Arudy. Despite the irregularity of the water power available, excellent results were obtained, and a larger and improved plant operating on the same system is now in use in Ugine (Savoy).

Fig. 2 represents diagrammatically the arrangement of a 400-KW. furnace as used at Ugine. The chamber A is 3 ft. 6 in. deep × 4 ft. internal diameter, and is of *pisé* construction, electrode paste being used in building it. The dome of the chamber is electrically insulated from it, even at red heat. Arc and resistance heating are employed, *a* A forming one, and a carbon cylinder B (7 ft. 6 in. × 1 ft. 6 in.), the other electrode. A 500-K.V.A. transformer, installed 4 ft. 6 in. away from the furnace and fed at 20,000 volts, supplies 52-56-volt, 50-cycle current. The design of the furnace is such that the metallic frame of A is in one piece magnetically and the power factor very near unity.

Ore is stacked on top of the furnace and 660 lb. of the partially dried material (mixed with a suitable proportion of granulated cast-iron), is introduced at intervals of two

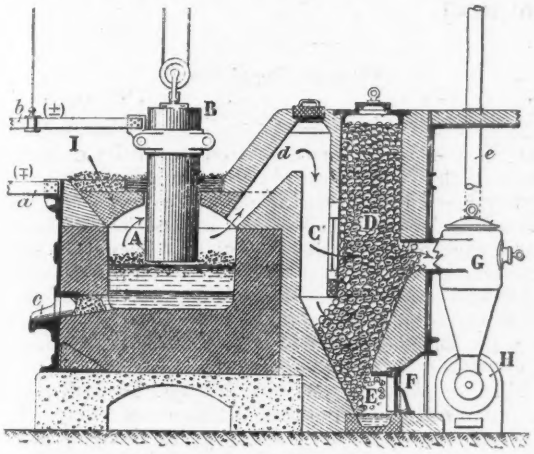


Fig. 2.—Section of Electric Zinc Furnace: Côte and Pierron Type.

hours through two symmetrically placed orifices in the direction I. Slag is removed at C, and zinc vapour escapes *viâ d*. For some moments after each charge is introduced, air, moisture and CO_2 are expelled. Fusion then commences and some zinc vapour is condensed in C (the temperature of which is regulable). Foreign materials volatilised in A and carried over by the zinc vapour pass, as shown, through a column of large pieces of carbon—introduced cold into *d*, and gradually brought to red heat as they descend. Vapour escaping the condensation and filtration in C D passes into a large vessel G, where there collects zinc powder, very pure and oxidised to a minimum extent. This powder falls to an electrically-heated melting chamber H, and vapours incapable of condensation escape by E; zinc condensed in C D collects in E. The red hot carbon in D prevents access of air to A when F is open.

When zinc-white is to be made, the temperature of C D is raised so that practically all the zinc is carried into a combustion chamber mounted in place of G. When using the furnace to produce metallic zinc, it is easy to secure from 67-75 per cent. of the output at E, and it is expected that, in future, it will be possible to eliminate the chamber G H.

Work is being carried on at Ugine with a view to acquiring experience and training a staff to be employed in a projected plant of much greater capacity. In the equipment described above, 21,000 lb. of blende* was reduced in 72 hours; 6,540 lb. of iron turnings, and 990 lb. of flux were used, and 6,200 lb. of 99·06 per cent. zinc,† and 1,180 lb. of 34·72 per cent. slag‡ were recovered. The slag collected at *c* weighed 21,500 lb., and contained only 1·85 per cent. zinc. The total loss of zinc was about 11 per cent. in this case, but experience justifies the belief that this figure will be reduced in future. The L.T. electrical energy consumed was 16,285 KW.-hours (2·6 KW.-hours per lb. of zinc at E, H), and the cost of the treatment was as follows:—

Treating 7,000 lb. 34-38 per cent. Ore per 24 Hours.

	Cost per ton of ore.
Electrical energy 2,300 H.P.-hours at £2 per H.P.-year	10*s.* 6*d.*
Depreciation and maintenance of buildings and equipment	9*s.* 6*d.*
Electrodes—26·4 lb. at £19 5*s.* per ton (erected) ...	4*s.* 7*d.*
Iron recovered from FeS (allowing for sale of S) ...	3*s.* 4*d.*
Labour (17 hours at 4½*d.*)	6*s.* 5*d.*
Proportion of general charges (£4,000 per annum in a works treating 20,000 tons ore per annum) ...	4*s.* 0*d.*
Total	38*s.* 4*d.*

Corresponding cost per ton of zinc (6,400 lb. of ore) = 110*s.*

In view of the fact that the type of zinc furnace, hitherto in general use, consumes from 1·7 to 2·0 tons of coal per ton of ore, whereas the electric furnace requires only 2,300 H.P.-hours (corresponding to a fuel consumption of 3,800 lb. in modern steam-electric generating plant), it seems likely that the electric zinc furnace will come into use in colliery districts as well as in localities where water power is available.

In conclusion, the advantages of treating zinc ores in the electric furnace may be summarised as follows:—

1. Possibility of establishing foundries in regions, barren of coal but rich in zinc ore, at a capital expenditure far less than is required by Silesian retort foundries.
2. Reduction of loss of metal to half that sustained when using retort furnaces and highly concentrated ore.
3. Simplified operation; staff required is smaller and can be recruited from mountain peasantry.
4. Reduction in charges for ore transport and possibility of profitably working many large deposits, the low zinc content of which makes them commercially worthless in the present state of the zinc industry.

* Having the percentage composition:—H_2O, 1·04; Zn, 34·8; Pb, 2·63; Fe_2O_3, 10·86; SiO_2, 12·48; S, 21·12; $CaCO_3$, 7·34; Al_2O_3, 5·67; MgO, 2·34; various, 1·72 per cent.

† Containing 0·07 per cent. Fe, 0·81 per cent. Pb, and 0·86 per cent. other impurities.

‡ Returned to the furnace with poorer ore.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The City Guilds Examinations.

It has often been a puzzle to me how the lists of works of reference in the programme of the City and Guilds technological examinations are decided upon, and by whom.

They have not generally erred on the side of paucity and the rather amazing number for the subject electrical engineering in the current programme should be noted.

I believe I am right in saying that the books enumerated for certain past sessions (if not in the present list) have included some that are hopelessly out of date, and even some that were out of print.

The electrical engineering list would be more helpful to professors, teachers, and students if the prices of the books were included, and if some closer indication than the titles were given of their scopes.

These lists, presumably the work of one or two individuals, would be still more useful if they were carefully revised each year, and if the said professors and teachers had a voice in the revision. It should not be too much trouble at the end of each session to ask, say, 150 of the more prominent lecturers to revise the old list, and to take the sense of the majority in drawing up the new one. The constant crop of new books and revised editions fully warrants this procedure; and it would be nothing less than just to those who have undergone the throes of authorship.

It is something of an anti-climax to turn to the works of reference for electric wiremen's work, but there is a new point to be raised. Why was it that in the programme for 1911-12, and possibly some other issues, no works of reference were mentioned; and why are only four books given in the current programme, one of them being somewhat out of place? It is significant that two of the four

were published subsequent to the above date, when no list was given; and if one did not know, one might assume that there was only one book on wiring in existence then. So far from this being the case, one might cite Clinton's "Electric Wiring," Ibbetson's "Theory and Practice of Electric Wiring," and "Electric Wiring, Fitting, Switches and Lamps," by an author who shall be nameless.

The first of the above-mentioned books saw the light in 1902, and besides two reprints, has just reached its third edition. The last-mentioned work was first published in 1899, and (not to mention various reprints) it reached its fourth edition in January, 1911. The question is, why were neither of these (or Ibbetson's) considered worthy of inclusion in the current programme? Perhaps Mr. Frank Broadbent may be able to explain.

Apart from this, I think the views of professors and teachers on the matter of revision would be of interest.

W. Perren Maycock.

West Norwood, S.E., *September 4th*, 1913.

The Electric Lighting of Trains.

I have read with interest your article in your current issue on the question of electric lighting of trains, but I think that you have overlooked some of the most important points.

It is not yet at all conclusive that the fire at Aisgill was due to gas, in fact it is more likely due to ashes from the wrecked engine setting on fire the splintered woodwork of the carriages, but supposing it is proved that the gas aided, or even caused the fire, surely it is just as unreasonable to make this outcry against carrying gas, as it would be to argue that motor-cars should not carry petrol, which is more dangerous than gas, and in either case a light must be applied to start the fire; besides, in all methods of locomotion it is impossible not to take some risks. Furthermore, are the public and the Press quite convinced that electric light is so much safer than gas, as whenever a large house is burnt down, it is nearly always attributed in the daily Press to the "fusing of an electric wire"?

I cannot agree with you that there is "no reason why electricity should not be used for lighting, heating, and cooking on the main line trains," as I think there are many good reasons, of which I might give a few. First, there has to be found a system of lighting which makes a coach independent of its service, as in most cases the equipment on any coach has to be adjusted to suit the service. Secondly, the locomotive engineers already complain of the additional load on the engine due to electric dynamo-driving, and if the whole of the lighting were electric this load would be largely increased. If the heating and cooking were also added, I am afraid it would be the rule rather than the exception to see two engines on a main-line train. Further, with regard to heating and cooking, there is already frequently a difficulty to find sufficient room under a coach for dynamo and batteries for lighting purposes, so that I venture to suggest that it would not be possible to accommodate sufficient apparatus for the enormous cooking and heating currents which would be required.

I cannot follow the argument as to the lighting and heating on the tube railways being electric, as when there is such an abundant supply of cheap electricity available, I cannot conceive anyone even thinking of introducing gas or steam for lighting or heating.

Although I am in the electrical engineering profession, and I should like to see more electric lighting of trains, I do not agree with a blind outcry against gas without considering the feasibility or even the possibility of entirely replacing it by electricity. I have not discussed the question of cost, as this, I think, does not materially affect the question of safety or possibility of electricity.

Fair Play.

[Proofs are accumulating that the fire was undoubtedly due to gas—*vide* the evidence given before the Board of Trade Inspector. One can get out of a motor-car easily enough in case of fire. No train has ever been set on fire by the electric lighting installation—nor ever will be, the voltage being only 24 volts; the battery connections, too, are sure to be broken when a coach is wrecked, and fuses are provided. There is no inherent or insuperable difficulty in making every coach for all practical purposes independent of the service as regards its electric lighting equipment. The extra load on the locomotive is about 2 per cent. of its normal output—an insignificant fraction—and this on a long-distance train lighted throughout with electricity. The mid-day meal is served in daylight, when the lighting load is off; the dynamo can supply the current direct—besides, how much of the cooking is actually done *on the train*? We have studied the subject for years past, and we know, as everyone knows who has done so, that it is quite feasible to fulfil all requirements with electricity. Our correspondent would do well to study the paper read before the Institution of Civil Engineers by Mr. Roger T. Smith, electrical engineer to the Great Western Railway (see abstract, Elec. Rev., December 15th, 1911), and other articles on the subject (*e.g.*, p. 406 of this issue), as he is clearly not familiar with modern practice.—Eds. Elec. Rev.]

Pressure Regulation.

In his article in your issue of September 5th, Mr. Turnbull states that in the event of the supply of steam being shut off from a self-excited compound-wound D.C. turbo-generator, the shunt field would disappear and the generator would run as a series motor and attain excessive speed. But how could the shunt field disappear? So long as it was connected across the brushes it would still be excited. It is true that, when running as a motor, the series field would oppose the shunt field, and might possibly weaken it sufficiently to allow the machine to run up to a dangerous speed; is this the explanation? And could not the danger be guarded against by a reverse-current breaker?

With regard to the difficulty that Mr. Turnbull speaks of, in working mid-wire boosters at very low voltages, it would be interesting to know whether he has experienced any similar difficulty in connection with reversible battery boosters, which often have to work at practically zero voltage with heavy armature currents. The writer cannot say that he has noticed any such difficulty, although he has had to do with a good many reversible battery boosters, automatic and otherwise.

G. C. Allingham.

Hendon, N.W., *September 8th*, 1913.

The Status of the Shift Engineer.

Once again that hackneyed phrase "the status of the shift engineer" occurs in your "Correspondence" columns. This time two correspondents are indignant that the shift engineer is about to lose his beloved status; perhaps it is because this is all he has left, his salary seemingly being of very little account nowadays.

The poor shift engineer is being classed with skilled workmen! There are hundreds who would only be too glad to be classed as such, and *paid* accordingly. I could name a number of stations where the stokers are paid more than the charge engineers.

It is a generally acknowledged fact that status to-day is £ s. d., the status varying directly as the amount of £ s. d. at one's command. The electrical engineer with his low salary consequently has a very queer status.

The root of all the troubles of electrical engineers is this "social status," "social respect," as your correspondents call it.

If electrical engineers would forget all about status for a time, and *demand* fair and equitable payment for their services, the status would look after itself. It matters little how you are classed by your employer, provided he pays a fair salary—public opinion will put you in your proper place.

Perhaps most shift engineers think they are embryo chief engineers (but it is surprising, when investigated, how few chief engineers of to-day have ever been in charge of a shift); this makes the average shift engineer compare himself with doctors, lawyers, &c., and at the same time

accept less payment for his services than builders' labourers demand and get.

In the preceding paragraph I have used the words: "demand fair and equitable payment"; the electrical engineer has never demanded anything; he has a great power, and has been afraid to use it.

In your columns and elsewhere, very good arguments have been put forward why electrical engineers should be paid fair salaries. From experiences all over the country, it has been found that chief engineers, Electricity Committees, &c., are very little affected by good arguments; they ignore them. A power behind these arguments would alter the aspect of affairs considerably.

From observation it seems that the power to demand is the foundation of the status of any profession.

W. J. Ebben, *Hon. Secretary,*
Association of Electrical (Station) Engineers.

London, E., *September 9th*, 1913.

I was very much interested in reading the two letters on the above subject in this week's paper.

It might be interesting to the writers to know that out of the four shift engineers originally appointed for the central station of the General Post Office, three resigned within two years of the commencement of supply, and also that no fewer than six vacancies, including the three shift engineers above, occurred in the staff for the scheme within two years. This will, I think, prove that the engineers could see that the future prospects of service under Government were about as bad as they possibly could be, and it has now been brought to the public notice in the Parliamentary Committee's Report, where they class the shift engineers on a level with drivers and stokers as "skilled workmen."

Of the engineers who left, some are now in responsible positions, and thankful to be out of Government service. It may also be a warning to others very carefully to consider the future prospects when appointments are offered them from this quarter.

When the scheme was first started, most of those appointed were experienced men, and had been through colleges, workshops and central stations.

It is quite time that the engineering department of the General Post Office had a thorough "spring cleaning," and that proper treatment should be given to those who are in such a responsible position as that of keeping the central station running at Blackfriars, upon which the General Post Office depends for its lighting and power, and also the Central Telephone Exchange.

I am glad to say that I am not in Government service.

E. Nest.

New Japanese Lamp Works.—New works for the manufacture of incandescent lamps have just been completed at Nishi-Hiranuma, by the Yokohama Denki Kogyo Kaisha. The company, which has a capital of £50,000, hopes to turn out about 10,000 lamps per day.

PROCEEDINGS OF INSTITUTIONS.

The Electric Refining of Steel in an Induction Furnace.

By Otto Frick (London).

(*Abstract of paper read before the* Iron and Steel Institute *at Ghent, September*, 1913.)

The results given in the paper are based on data obtained in the Frick furnaces at Krupp's works in Essen. Two furnaces of this type are at work. The first came into regular operation in August, 1908. The second furnace, originally of the Kjellin type, was rebuilt on the same principle as the first Frick furnace, after this had been proved superior both in design and with regard to power consumption and efficiency.

The data relating to these 10-ton furnaces are:—

Raw materials	cold scrap of good analysis.
Actual working capacity ...	8·5 tons.
Weight of casts	6·5 „
Average power used	650 KW.
Frequency	5 cycles per second.
Voltage	5,000
Power factor, cosine ϕ at 8·5 tons	0·53
Average duration of one heat ...	6 hours 45 minutes.

Theoretical energy consumption per ton, 432 KW.-hours calculated. Average electrical loss, 4·5 per cent.; average radiation loss, 160 KW.; average total efficiency, 70 per cent.

Figs. 1, 2 and 3 give a clear idea of the design of the furnace, and figs. 5, 6 and 7 show sections of the single ring and double ring furnaces. Fig. 3 represents the 10-ton furnace in plan.

As the furnace was to be used for melting cold scrap only without any refining, the original type with a rotating cover was chosen, being specially designed for the treatment of cold scrap and offering the advantage of easy charging and distribution over the whole crucible without any delay or trouble. The rotating cover further facilitates the supervision of the metal and of the furnace walls. Additions of slag or alloys are quickly and evenly distributed over the bath. The design of the cover has proved most satisfactory for its purpose.

The electric losses, that is, the losses in the primary coils and in the magnetic iron core, are reduced by giving these parts ample dimensions. Notwithstanding the great weight of the core, nearly 45 tons, the total electric loss in the furnace in Essen only amounts to 4 or 5 per cent. of the total energy supplied to the furnace.

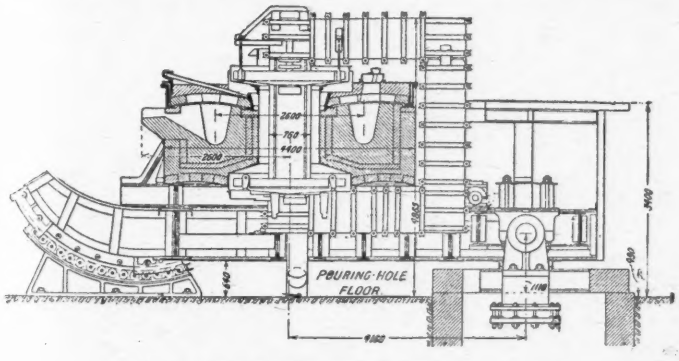


Fig. 1.—Longitudinal Section.

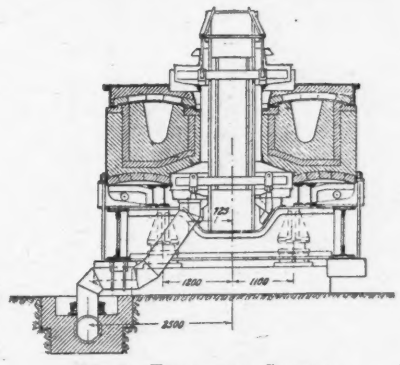


Fig. 2.—Transverse Section.

10-Ton 1,000-h.p. Frick Furnace at Krupp's Works, Essen.

Of greater influence on the efficiency are the losses due to radiation. The author has made a careful study of the heat conductivity of refractory materials at highest temperatures, and has provided his furnaces with insulated walls in accordance with the results. Further, great care was taken to make the doors in the cover tight and as easy as possible to keep closed. By these means the radiation losses were reduced to a minimum. Comparative calculations have shown that the radiation loss of the Kjellin furnace exceeds that of the Frick furnace by 75 KW. or 48 per cent., which also involves an increased cost for current, labour, and lining in the case of the former.

As an example, a run of six weeks' duration may serve.

	Kjellin.	*Frick.*
Output in six weeks, good ingots, tons ...	696	850
	Shillings.	
563,500 KW.-hours at 0·43 penny	20,250	
Labour estimated at...	5,900	
Lining...	2,000	
Light, cooling fan, &c.	450	
Total costs in six weeks	28,600	
Costs per ton of ingot	41·10	33·70
Saving by Frick furnace, per ton	7·40	
„ „ „ per campaign ...	6,300	
„ „ „ in one year of seven campaigns with one furnace	44,000	

£

Were 12 per cent. interest and depreciation on an estimated outlay of £12,500 also taken into account, the annual saving would be increased to £2,500. These figures demonstrate the importance of low radiation losses, and prove the effectiveness of the design of the Frick furnace in this respect.

Nearly six years of actual working have shown that no drawbacks have been caused by the insulation of the furnace.

At the Krupp works a Girod furnace of 1,200 KW. and 12 tons capacity has been installed next to the Frick furnace, thus giving an opportunity to compare the Frick furnace with a furnace of the arc type. The following figures represent average results, and will give a fair idea of the relative efficiency of the two types:—

KW.-hours per ton of steel in the Girod furnace ... 1,000 KW.-hours.
" " " Frick " ... 600 "

It may be assumed that the theoretical energy consumption of the Frick furnace is 425 KW.-hours per ton. For the Girod furnace it has been assumed to be somewhat higher, or 460 KW.-hours per ton, as it is possible that this furnace is working on a raw material with more scale or rust, and therefore under less favourable conditions.

It has been assumed that the Frick furnace has an interval of only 7½ minutes between heats. For the Girod furnace two cases have been calculated, viz., for an interval of 55 minutes and for one of 1 hour 25 minutes per heat, the longer intervals being necessary for charging, which has to be completed before the current can be turned on, whereas in the Frick furnace the current may be put on immediately after tapping. It may then be calculated that—

The average loss of the Frick furnace = 186 KW.
" " Girod furnace = 580 "

or over three times more than the Frick furnace, although the capacity of the latter is only 20 per cent. less.

In the Frick furnace the heat is generated directly in the steel bath, and, consequently, there is practically no heat transfer necessary, but the highest temperature prevails in the metal itself. Further, the slag acts as a very effective heat insulator, which prevents the furnace walls above the bath and the roof from becoming as hot as the bath itself.

In an arc furnace the essential part of the heat is generated in the arc or arcs playing between the ends of the electrodes and the metal, and, consequently, the heat has to be transferred from these centres to the other parts of the bath by heat transmission, which requires a very high temperature in the arcs and at the lower end of the electrodes, a temperature which certainly exceeds 2,500° C., whereas the highest temperature in a Frick furnace never exceeds 1,680° C. at any part.

It must also not be forgotten that the electrodes themselves are fairly good heat conductors, and through them no small amount of heat is conveyed away out of the furnace. In melting cold scrap the conditions are somewhat more favourable, as the electrodes are surrounded by the charge, which absorbs some of the heat otherwise dissipated towards the roof.

It may therefore be concluded that the efficiency of an arc furnace for treating liquid metal will always be less than 50 per cent., and in melting cold scrap will only slightly exceed 50 per cent. The Frick furnace, on the other hand, shows an efficiency of over 70 per cent., which may be further improved with larger furnaces.

With regard to the lining, the induction furnace offers certain intrinsic difficulties through the ring-shaped form of the crucible. On the one hand, greater difficulties arise in making the lining stand high temperatures without cracking, on the other the ring-shaped form makes it impossible to give the furnace walls sufficient slope to enable the repair to be made in the same manner as in an open-hearth furnace, or simply by throwing dolomite or magnesite on the places which have been cut by the slag. The upper part of the inner wall, which is the one most exposed to the cutting by the slag, may be sufficiently sloped to allow a repair in this manner, but it would mean considerably increased dimensions of the furnace and increased losses and energy consumption. To make the dimensions as small as possible, it is thus necessary to make the walls almost vertical.

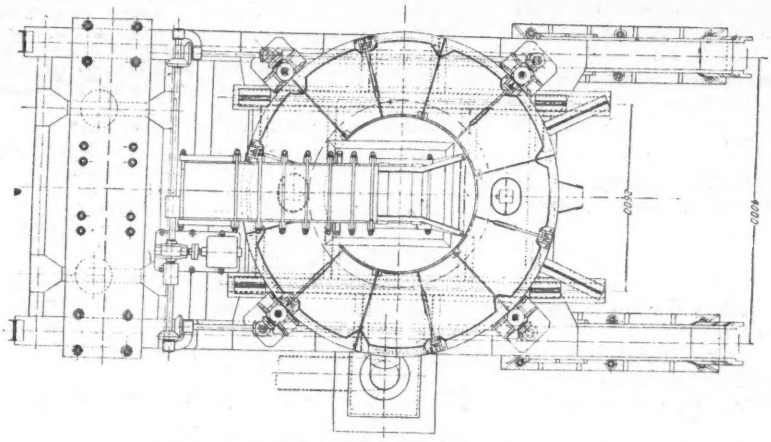


Fig. 3.—Plan of 10-ton Frick Furnace, 1,000 H.P.

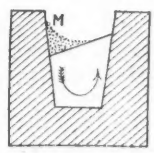


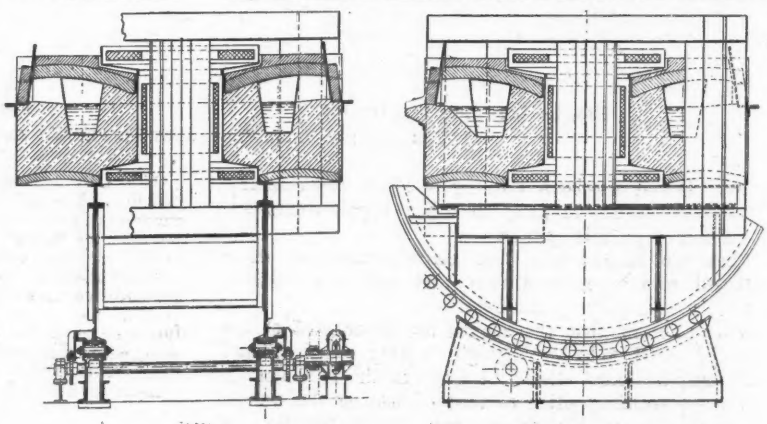
Fig. 4.

The difficulties with regard to cracking are due to the fact that the outer wall is ring-shaped, and has its highest temperature on the inside, whereas the equally ring-shaped inner wall is hottest outside. The only possible way of overcoming these difficulties consists in using a material which has practically no contraction or expansion at very high temperatures.

The lining at Essen was the outcome of most extensive researches and much experimental work; it is made of magnesite of the highest purity, preferably up to 93 per cent. MgO, without any binding agent, and treated in such a way that it neither contracts nor expands up to the highest temperatures. It possesses a remarkable compactness, mechanical strength, and resistance to the action of slags.

But even the best of linings will not stand more than a few weeks if it is not further protected against the cutting action of ordinary slags. As all attempts to repair a cut place in the lining have proved to be of little or no value, the author was led to a very simple solution, especially adaptable to his furnace, by the following consideration.

As all basic slags contain a certain percentage of MgO, which seldom exceeds 10 per cent., and usually runs at about 6 to 7 per cent., the conclusion is justified, that basic slags must saturate themselves to this extent. If now such slags are given an opportunity to take up MgO from another source, they will not attack the lining. By adding crushed magnesite in such a way that the slag can become saturated before it has been able to attack the lining, this ought to be protected against cutting, and should last for a considerable time.



Figs. 5 and 6.—Sections of Frick Single ring Single-phase Furnace.

Such an automatic preservation of the lining is much facilitated by the inclination and rotation of the bath, which will be more fully described later on. Old magnesite, without any value for other purposes, may be used. It is introduced into the furnace in such a manner as to form a heap in front of the inner wall, against which it is pressed by the inclination and rotation of the bath. The sketch, fig. 4, shows a section through the lining and the bath, with its surface inclined towards the inner wall. The slag additions, mixed with magnesite, are shown as a heap M, and the rotation of the bath is indicated by an arrow.

The silicon and phosphorus in the steel are brought to the

surface near the outer wall by the rotation of the bath, and are in this way brought into contact with the air or with the oxides of the slag, which they rob of the necessary amount of oxygen for the formation of Si_2O and P_2O_5. These oxides float on the inclined surface of the bath and meet the heap M, from which they absorb the necessary amount of MgO and CaO before they reach the wall. This method has proved to be most satisfactory, and it has even been found possible to make the inner wall grow by adding too much magnesite, and to cut away the excess by diminishing the percentage of magnesite in the slag.

The lining of the Frick furnace at Essen now attains a life of two to three months regularly. The rotating cover of the furnace facilitates the distribution of the magnesite or the magnesite lime mixture along the inner wall. The roof of a Frick furnace, if not revolving, can be made to last at least as long as the lining.

The reciprocal electromagnetic action of the current in the primary coils and in the bath produces the double effect of making the surface of the bath take an inclined position towards the inner wall, and of causing the whole of the molten metal to revolve in the direction shown by the arrow in fig. 4.

The inclination of the bath surface causes the slag to be carried towards the inner wall. If the angle of inclination is too sharp, or the quantity of slag too small, the surface of the metal will be uncovered and exposed to the oxidising action of the air if the furnace is not well closed. A very small inclination is sufficient. With an angle of 4° and with a thickness of the slag of 1 centimetre at level bath the width of the uncovered part will be 51 per cent. if the total width of the bath is 12 in.

The disadvantage of the inclination, if it is excessive, consists in the greater quantity of slag necessary to cover the metal. The experience with the furnaces at Essen shows that the Frick furnace in this respect also is superior to induction furnaces of the Kjellin type. The following inclination of the bath surface has been measured:—In the Kjellin furnace, 24°. In the Frick furnace, 4° 34′ to 5° 5′. The amount of slag required in the Kjellin furnace is 4·5 to 5 times that required in the Frick furnace.

TABLE I.—Single-ring Furnaces for Steel.

Capacity in tons	0·3	1·0	3·0	10·0	20·0
Normal power-consumption, KW.	80	180	375	950	1,750
Normal frequency, cycles per second	50	15	8	5	5
Power factor at normal frequency	0·53	0·70	0·68	0·56	0·39
Radiation loss at 1,500° C., KW....	35	68	104	160	230
Electrical losses, per cent. ...	9·0	6·2	4·7	3·2	3·1
Maximum efficiency at 1,500° C., per cent....	42	56	64	77	81
Efficiency, if stops 25 per cent. of total time, per cent.	24	37	53	70	75
Maximum weight of cast, cold charging, tons	0·10	0·50	1·95	7·7	16·5

TABLE II.—Single-phase Double-ring Furnaces for Steel.

Capacity in tons	0·6	2·0	6·0	20·0	40·0
Normal power-consumption, KW.	145	320	690	1,800	3,400
Normal frequency, cycles per sec.	50	15	8	5	5
Power factor at normal frequency	0·53	0·70	0·68	0·56	0·39
Radiation loss at 1,500° C., KW.	61	115	168	267	374
Electrical losses, per cent. ...	7·5	6	4·5	3	2·5
Maximum efficiency at 1,500° C., per cent.	45	54	68	79	83
Efficiency—					
If stops 25 per cent. of total time, per cent.	28	40	58	73	78·5

The rotation of the bath is favourable in so far as it secures a great uniformity of the metal and assists in the protection of the lining, as mentioned above, as well as in hastening the reaction between the slag and the metal. For all these purposes an exceedingly slow rotation of about 1 R.P.M. would be sufficient, whereas it is generally many times more, and under unfavourable conditions may exceed 100 R.P.M. Every means should be used to keep the speed of rotation down. This is done in the Frick furnace by the arrangement of the coils, and by using a current of low frequency for the operation of the furnace. While the steel in the Frick furnace was practically calm, that in the Kjellin furnace seemed to rotate at a great speed, producing the effect of fierce boiling near the inner wall.

In comparing arc furnaces with the Frick furnace it should be mentioned that the amount of slag necessary to cover the bath of an arc furnace is less than in the latter type. As, however, the Frick furnaces at an angle of inclination of 5° only require about 22 kg. of slag per ton of steel in single ring, and about 28 kg. in double-ring furnaces to cover the bath, the saving cannot be considerable.

It may be assumed that the arc furnace only requires 18 kg. of slag to cover the bath and to complete the metallurgical reactions. The saving would be 4 kg. over the single-ring and 10 kg. over the double-ring Frick furnace, the melting of which represents a theoretical energy consumption of about 2·5 or 6·5 KW.-hours per ton of steel respectively. This higher theoretical energy consumption of the Frick furnaces is compensated by its higher efficiency.

For comparison it may be assumed that Frick furnaces have an efficiency of 70 per cent., as at Essen, and that the arc furnace has an efficiency of 40 to 30 per cent., the higher value probably being the very highest efficiency which can be obtained in an arc furnace working on hot metal, while the latter figure generally is not exceeded.

Even in this exceptional case, and with current at the price of only ½d. per KW.-hour, the single-ring Frick furnace comes out better than the arc furnace under all conditions, and the arc furnace has the advantage over the double-ring furnace only if its efficiency is above 30 per cent.

It may be said that the future of the electric furnace for steel production will be in the final refining of steel, pre-melted and pre-refined either in a converter or open-hearth furnace, and that its use for melting cold stock, except in places with very cheap water power and high priced fuel, will be restricted to comparatively small quantities of high-class alloy steel, and to the melting of valuable alloys for the addition to ordinary steel, if a saving of alloy can be effected by melting under exclusion of air, as, for instance, for the melting of ferro-manganese.

The success of the large furnaces at Essen has warranted the building of still larger types, up to 20 tons capacity as single-ring furnaces; and to meet demands for still larger capacity, double-ring furnaces up to 40 tons have been designed.

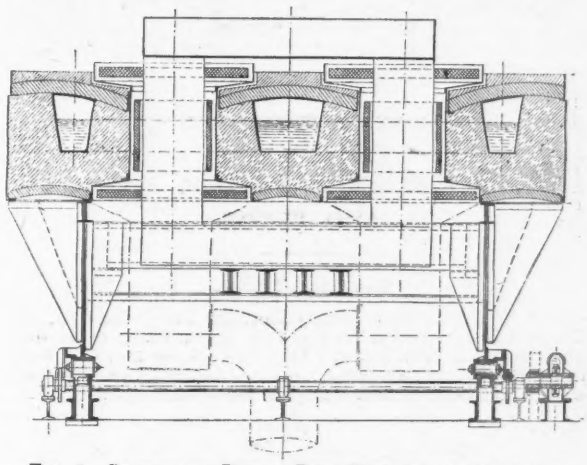


Fig. 7.—Section of Double-Ring Single-phase Furnace.

All the furnaces will preferably work with single-phase current, although the double-ring type may also be made to take a two or three-phase current.

Figs. 5 and 6 show the design of single-ring furnaces of 0·3 to 20 tons capacity.

Fig. 7 shows the design of double-ring furnaces of 0·6 to 40 tons capacity for single-phase current. The only difference in double-ring furnaces for two or three-phase current consists in the use of two independent iron cores instead of the one common to the two rings formed by the bath as shown for the single-phase double-ring furnace.

Tables I and II contain general information on single-ring and double-ring furnaces for steel.

As induction furnaces have a very low power-factor at the normal frequencies of 25 to 50 cycles, it is only in exceptional cases advisable to connect them directly to existing plants. It will in no case be economically justifiable to connect furnaces for steel of over 3 tons, and for ferro-manganese of over 6 tons capacity, to a supply system of 25 cycles.

The single-ring single-phase furnace, as a rule, is cheaper in first cost, and much more economical in use on account of the lower radiation loss.

Even with an extra dynamo the first cost of the Frick furnace plant will be lower than that of an arc furnace of any of the existing types, considering the much smaller plant needed by the Frick furnace on account of its higher efficiency.

Furnaces for melting ferro-manganese are generally smaller, and may with advantage be connected to a system of 25 or 50 cycles.

A low frequency offers appreciable advantages with regard to the electric losses in the coils and in the iron core.

The Frick furnace can be constructed for any voltage up to 5,000 volts, and higher for larger furnaces. The furnace at Essen has been in operation for nearly five years with current at 5,000 volts, the high-tension parts being all insulated in such a way that it is impossible to come in contact with them. One advantage of a high voltage is that the cables are smaller, less costly, and easier to fix.

A great advantage of the induction furnace is the high load-factor and the absolute uniformity of the load without shocks or variations. In this respect the induction furnace differs favourably from arc furnaces, which even when treating liquid metal give rise to serious short circuits, especially when the metal is boiling as during the oxidation period. The only way to reduce these short circuits is by lengthening the arc and reducing the load. The load-factor is of no little influence on the production, and thereby on the cost per ton of steel.

In comparing a 15-ton 1,750-KW. arc furnace with a Frick furnace of the same capacity and power, it is certainly not unfavourable to the arc furnaces to assume a load-factor during

the heat of 90 per cent., as against a load-factor of 100 per cent. attainable by the indnction furnace. But this means 10 per cent. higher production and 10 per cent. lower cost per ton of steel.

Amongst metallurgists the conviction is general that the induction furnaces are not, and cannot be, suitable for refining.

This opinion about the importance of a thin slag has its origin from the experience with open-hearth furnaces. The induction furnace, far from being a poor refining apparatus, in reality offers decided advantages over all other furnaces.

Altogether excellent results with regard to desulphurisation have been obtained in induction furnaces, amongst which those in Dommeldingen might be mentioned, where, according to analyses published in *Stahl und Eisen* of 1911, steel of 0·012 per cent. sulphur to traces, with an average of 0·008 per cent. sulphur, has been produced out of a raw material containing about 0·04 per cent. sulphur.

In the electric furnace the following reactions may be carried out: (1) Decarburisation; (2) desiliconising; (3) dephosphorisation; (4) deoxidation; (5) rephosphorisation; (6) desulphurisation; (7) recarburising; (8) alloying with silicon, manganese, nickel, chromium, tungsten, &c.

On account of the possibility of completely deoxidising both metal and slag, the electric furnace is eminently suitable for the manufacture of all kinds of alloyed steels, as it will not only save the losses of metal, occurring in other furnaces, but will also greatly facilitate the obtaining of correct analyses. Through the gentle rotation of the bath in the Frick furnace, a perfect distribution of the alloys and an absolute uniformity of the product can be secured.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

The Royal Heater.

The Edison & Swan United Electric Light Co., Ltd., of Ponder's End, are introducing a new heater, fig. 1, under the Bastian patent. This heater, in an elegant brass case, is of best London make, and suitable for use in drawing rooms, boudoirs, first-class state-rooms aboard ship or any superior apartment. It

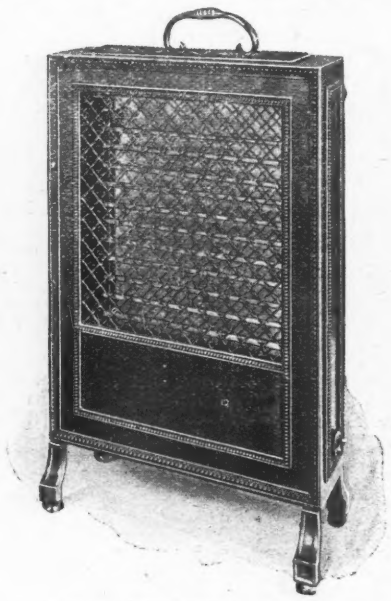


Fig. 1.—The "Royal" Heater.

is usually fitted with two switches and 12 Bastian glowers of 1,500 watts capacity, but the same pattern can be supplied fitted with eight glowers only of 1,000 watts capacity. It stands 19 in. high, has a depth of 5 in., and breadth of 12 in.; the weight is 10 lb., and energy consumption ¾ to 1½ units per hour (12 glower) or ½ to 1 (eight glower).

New Ozonair Apparatus.

Messrs. Ozonair, Ltd., of 96, Victoria Street, S.W., have recently brought out two entirely new designs of ozone generators, which are illustrated herewith. Fig. 2 shows a portable pattern, type No. 28, for alternating current only, which is not provided with a fan, nor has it any moving parts; a three-point regulator enables the strength of the ozone to be varied. The apparatus weighs only 20 lb., and is exceptionally neat and simple. The other illustration shows types Nos. 26 and 27, for A.C. and D.C. respectively, which have been designed mainly for use in tropical and humid climates; the ozone generator is enclosed in a special compartment, with shutters which close the air inlet and outlet when ozone is not being generated.

Fig. 2.—Portable Ozone Generator, Type No. 28.

The fan motor is entirely accessible for lubrication and renewal of brushes, and a regulator is provided to control its speed, with a

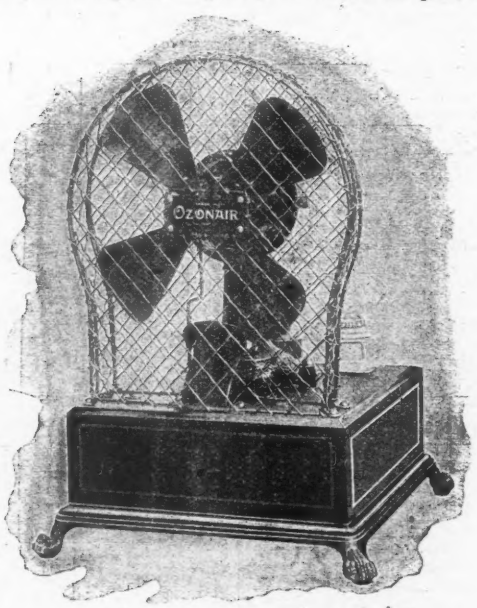


Fig. 3.—Portable Ozonair Apparatus, Types 26 and 27.

four-way switch which also controls the ozone generator and operates the shutters.

BUSINESS NOTES.

The German Glow-Lamp Market.—The situation of the market for incandescent lamps is referred to in the report for 1912-13 of the Wolfram Lampen Gesellschaft, of Augsburg, which underwent financial reconstruction in the past year. The market is characterised as having been unfavourable owing to the too rapid promotion of new factories for the manufacture of wire lamps and the extension of the productive capacity of others. Nevertheless, the company's new type of lamp has been successful in competition with lamps having drawn-wire filaments. A severe trade contest, however, may be expected in the future, and a change in this respect could only be effected by the combination of existing makers. The report also states that the patent action in regard to the manufacture of drawn wire, which has already proceeded for a year and a half, has not yet been decided, and the efforts of a group of manufacturers to monopolise drawn Wolfram wire, appear from the beginning to have no prospect of being successful, inasmuch as the process of manufacture became common property long ago through prior publication.

Book Notices.—*The Commonwealth Engineer.* Melbourne: The Tait Publishing Co. Pty., Ltd. Monthly, price 6d. —Mr. Peter Tait, well known as the publisher of the *Mining and Engineering Review*, has recently added to his publications a new monthly journal—the *Commonwealth Engineer*—the first number of which is to hand. Uniform in style with the *Review*, it is the intention to include in its pages matters relating to civil, mechanical, electrical and railway engineering, for which it has been impossible in the past to find sufficient space in that paper, which is, of course, mainly devoted to mining and metallurgy. The first issue, which makes very interesting reading, contains a series of articles, many of them illustrated, dealing with electrical matters, dock work, water supply, concrete bridge work, Australian timber, &c. We gather that considerable support has been promised to the new venture, which has our best wishes.

"Researches in Magneto-Optics." By P. Zeeman. 1913. London: Macmillan & Co. Price 6s. net.

"Factory Lighting." By C. E. Clewell. 1913. London: Hill Publishing Co., Ltd. Price 8s. 4d. net.

"Dynamo Lighting for Motor-Cars." By M. A. Codd. Price 2s. 6d. net. "Molesworth's Pocket-Book of Useful Formulæ and Memoranda." 1913. Price 5s. net. "Science Abstracts." Sections A and B. Vol. 16, part 8. August 30th, 1913. Price 1s. 6d. net each. London: E. & F. N. Spon, Ltd.

"*Journal* of the South African Institute of Engineers." Vol. XI, No. 12, and Vol. XII, No. 1. July and August, 1913. Johannesburg: The Institute. Price 2s. each.

"*Proceedings* of the American Society of Civil Engineers." Vol. XXXIX, No. 6. August, 1913. New York: The Society.

"United States Government Specification for Portland Cement." "Analysed Iron and Steels—Methods of Analysis." "Analysed Iron and Manganese Ores—Methods of Analysis." 1913. Washington: Government Printing Office.

"Atti della Associazione Elettrotecnica Italiana." Vol. XVII. No. 15. August 15th, 1913. Milan: Stucchi, Ceretti & Co. Price L. 1.50.

Ironising Boiler Tubes.—Mr. Sherard Cowper-Coles has granted a licence to the British Mannesmann Tube Co. for ferro-zincing and ironising boiler tubes to prevent corrosion or pitting; they are erecting a plant at their Landore works for this purpose. The process consists of coating the tubes with a thin layer of pure iron, which may or may not be afterwards coated with zinc. The coating of pure iron is found to be very inert to chemical action and thus forms a good protective covering.

The "Weak-Current" Industries in Germany.—It is stated that efforts have been made in Germany for some time past with the object of bringing about a combination in the weak-current (telephones, telegraphs, &c.) industries for the purpose of counteracting depression in prices. An agreement has already been reached in certain classes of manufactures. But owing to the multiplicity of the products dealt with, great difficulty will be experienced in securing a close association of all the works concerned.

Extensions at the Cyclone Works.—Correcting an item which recently appeared in our "Contractors' Column," MESSRS. MATTHEWS & YATES, LTD., inform us that their extensions were completed by the beginning of this year. They consist of, first, a building which doubles their capacity for making light sheet-iron work, used principally for ventilating ducts in connection with their fans, and gives them probably one of the largest sheet-metal works in the country for this class of work. The second extension is practically a new works, designed and specially equipped for heavier sheet-metal work and light constructional work, used partly in connection with the firm's ventilating, dust-collecting, drying and other schemes, in which fans are largely used, but also giving them facilities for constructional work for outside firms which is not particularly connected with fan work, such as steel hoppers, chutes and bins, oil separators, settling tanks, roof principals and light constructional work, &c.

Disclaimer.—MR. W. W. MARTIN, electrical engineer, of 320, Witton Road, and 84, Trinity Road, Birmingham, and 70, Coventry Street, Kidderminster, asks us to state that he has no connection with the Mr. A. E. Martin, recently mentioned under "Bankruptcy Proceedings."

Spanish Commercial Museum.—A Royal decree has been issued ordering the creation of a Museum of Commerce under the direction of the Ministry of Commerce, Industry and Labour. The object of the museum is the increase of commerce, and especially foreign commerce, by supplying information to Spanish producers and merchants as to the state of industries in Spain and abroad. It is intended to institute a permanent exhibition of samples, Spanish and foreign, methods of packing, &c.; an office for information on transit rates; an office for foreign trade; an office to supply information on Spanish and foreign tenders and contracts and other openings for business, and a section for experts' reports, publications, and a library. The museum will publish a catalogue of samples and a *Boletin Comercial* which will furnish a list of foreign firms wishing to enter into business relations with Spanish houses or others interested, as well as particulars of Spanish and foreign adjudications on tenders. There will also be established at the Ministry of Foreign affairs a "Centro de Informacion Comercial del Ministerio del Estado," which will likewise furnish information calculated to extend the commercial relations between Spanish and foreign firms and others concerned.

Catalogues and Lists.—GENERAL ELECTRIC CO., LTD.—"G.E.C. Monthly List"—a new feature, consisting of a leaflet so perforated that the respective sections of it can readily be separated, for the purpose of gumming them into the corresponding sectional catalogues. It is intended to distribute these monthly sheets to everyone on the firm's mailing lists, to keep their customers posted with the latest information regarding new types of apparatus, &c. The present sheet relates to new patterns of the "Geeko" double-line auto-reset intercommunication telephones, electric bells, and lead-headed wall nails for supporting cables.

BRIMSDOWN LAMP WORKS, LTD., Kingsway House, W.C.—Price list of "Wirum" lamps, all sizes from 8 to 1,000 C.P. and voltages from 25 to 260 volts.

THE OSTRO LIGHT CO., 11, Queen Victoria Street, E.C.—Leaflet giving particulars and prices of the "Ostro" lamps, with metal filaments.

HANS FICKENSCHER, Ritterstr., 31, Berlin S. 42.—Prospectus 53 of electric light lustres, pendants, lanterns, bead-shades, &c.

INTERNATIONAL ELECTRIC CO., LTD., 111-115, Salusbury Road, Kilburn, N.W.—Price List D, covering domestic, direct-working, central-battery and magneto telephones of a variety of types.

MESSRS. D. N. DOBSON & CO., 93, Aldersgate Street, E.C.—Price list of Dutch hand-made art-metal ware, including electric light fittings, from the "Cuprera" Art Metal Works, for which the firm are sole agents for Great Britain and the Colonies.

MESSRS. MATTHEWS & YATES, LTD., Cyclone Works, Swinton, Manchester.—Pamphlet No. 51, describing the "Cyclone" electric fans and exhausters for ventilation and kindred purposes, as well as the "Cylone" electric D.C. motor and the "Sirius" oxy-acetylene welding and cutting plant.

MESSRS. SIEMENS BROTHERS DYNAMO WORKS, LTD., Tyssen Street, Dalston, London, N.E.—Leaflet dealing with a new style of opal reflector under the name of "Marbella." These reflectors have a pleasing appearance, and eliminate glare, giving a pure, soft, white light; they are exceedingly easy to clean, and do not collect dust. They are made in concentrating and distributing types. Galleries are unnecessary, as these reflectors have a 1½-in. hole.

SIMPLEX CONDUITS, LTD., 116, Charing Cross Road, W.C.—Leaflet describing two larger sizes of their cast-iron ovens which are now being supplied, and a rapid water heater.

INTERNATIONAL RAILOPHONES, LTD., Prudential Buildings, Corporation Street, Birmingham.—Price list of railophone equipments, which are ready for prompt delivery. One of these equipments has been tested on a section of the German Imperial State Railways, near Berlin, with the result that an extension 10 times as long as the original plant has been ordered. The apparatus has been patented in 33 countries. Had it been installed at Aisgill, there would have been no collision.

Coal Mines Act, 1911.—Notice is given that the books containing the parts of the Abstract and General Regulations prescribed by the Secretary of State under Sec. 88 (1) (*b*) of the Act, in respect of the different classes of persons employed in mines, are now in the press, and will, it is expected, be on sale not later than September 13th at the Government sale agents—Messrs. Wyman and Sons, Ltd., Fetter Lane, London, E.C., and 54, St. Mary Street, Cardiff; H.M. Stationery Office (Scottish Branch), 23, Forth Street, Edinburgh; and Messrs. E. Ponsonby, Ltd., 116, Grafton Street, Dublin.

Sec. 88 (1) (*b*) requires the owner, agent, or manager of every mine to supply gratis to each person employed in or about the mine a book containing the parts of the Abstract and General Regulations prescribed as affecting him, and also to supply a copy, at a price not exceeding 1d., to any such person applying for it at the pay office of the mine.

A list of some of the classes of persons for whom separate books are required is given below, and the official reference number, which should be quoted in ordering books, is given in each case. The books will be published at the uniform price of ½d. each or 3s. a hundred.

	Mines and Quarries Form No.
Officials superior to the firemen, examiners and deputies	55
Mechanical engineers	56
Electricians and assistant electricians	58
Winding enginemen	59
Boiler minders	63
Persons in charge of ventilating machines	64
Shot firers	65
Hauling enginemen and persons engaged in mechanical or gravity haulage operations... ...	70

Underfeed Stokers.—Amongst recent sales of stokers by the UNDERFEED STOKER CO., LTD., are the following:—

Bradford Corporation, 2 E; Brompton and Kensington Electricity Supply Co., 2 E; Edinburgh Corporation Electricity Works, 2 B; Holloway Electricity Works, 2 B; Yorkshire Electric Power Co., 2 E; Luton Corporation, 4 E; Warrington Corporation, 1 E; Bury St. Edmund's Corporation, 2 B; Loughborough Corporation, 1 E; Lisbon Electric Tramways, 4 E; Philadelphia Power Station, 2 A.

A large number have also been supplied to manufacturing companies at home and abroad.

Dissolutions and Liquidations.—HOBART ELECTRIC TRAMWAY CO., LTD.—On August 15th and September 1st the company resolved that it be wound up voluntarily, and Mr. F. J. Warner, 11, Queen Victoria Street, E.C., was appointed liquidator with a committee consisting of Messrs. A. Mattei and J. G. Bellamy.

A meeting of creditors will be held at 126, Mansion House Chambers, 11, Queen Victoria Street, E.C., on September 16th, at noon. Particulars of claims to be sent to the liquidator by October 15th.

Gilbert Arc Lamp Co., Ltd.—A meeting will be held at 3, Fenchurch Street, E.C., on October 7th, at 3 p.m., to receive an account of the winding up from the liquidator.

Doncaster Electrical Co., Ltd.—A meeting will be held at 37, Manor Row, Bradford, on October 8th, at 11 a.m., to receive an account of the winding up from the liquidator.

Trade Announcements.—Messrs. The Ostara Metal-Filament Lamp Works, of Plauen, have now made arrangements to be represented in Great Britain at 105, Market Street, Manchester, and in future all trade inquiries will be dealt with from this address.

Larger and more convenient premises at 18 and 20, Parliament Street, Nottingham, have been taken by Messrs. J. Farr & Co., electrical engineers and contractors, of South Sherwood Street.

Bankruptcy Proceedings.—Wesley Sutton, traveller for electrical manufacturers' agents, 62, Dale Street, Liverpool.—Notice is given in the *London Gazette* of the release of trustee as from June 19th last.

Austrian Cable Manufacture.—The employment of the Austrian cable works, which was active down to the spring of the present year on the basis of old contracts, has since been very unsatisfactory. A considerable decline has taken place in the exports and in the receipt of private orders for the home market, whilst Government orders are entirely absent. The work in connection with the development of the Vienna telephone exchanges has also been postponed.

LIGHTING and POWER NOTES.

Abercarn.—It has been reported to the U.D.C., that the Risca District Council declines to co-operate in promoting a Bill, giving the local authorities power to provide electricity and electric traction in the district, and has intimated that it reserves the right to oppose any such scheme.

Argentina.—According to the *Review of the River Plate*, it was reported that the Farquhar Syndicate had obtained control of the Hydro-Electric Co., of Tucuman. It has also been reported that it is its intention to electrify a portion of the Argentine North-Western Railway; the company is supplying in Tucuman in competition with two existing companies and, according to our contemporary, the rates have been cut so low that even small mud houses of one room have the electric light.

Australia.—The South Perth (W.A.) Municipal Council intends to borrow £7,000 for the purpose of purchasing the electric light works, and making extensions to the plant.—*British Australasian.*

Balderton.—Public Lighting.—The electric street lighting carried out by the Parish Council has been inaugurated by Lieut.-Col. C. J. Huskinson, who switched on the current. The installation, which is on the overhead system, has been carried out by Messrs. Loxley & Co., and current is taken from the engineering works of Messrs. Simpson & Co., which are in the parish.

Battle.—Workhouse Lighting.—The B. of G. on September 5th decided to engage Mr. A. C. Ticehurst to draw up a complete specification for the electric light installation at the Workhouse, to supervise the work and to thoroughly inspect it on completion, at a fee of £12 12s.

Bognor.—Such rapid progress has been made by the local gas company with the construction of the electricity works, that it is hoped to have a supply of current available by the end of September.

Bradford.—A Satisfied Consumer.—A correspondent writing to a Bradford newspaper urges his fellow citizens to meet the advance of house coal prices by using electricity for heating, and gives a concrete example to prove that, by combining lighting and heating, the householder can easily save money on the use of electricity as against gas and coal. The illustration given from actual experience is as follows:—House of rateable value £19. Total cost of installation and equipment, from the entrance of the wire into the house to and including the provision of 16 lamps for lighting, and two four-light radiators with five connecting plugs, £20; cost of electricity supply for one year, £2 17s. at 3s. in the £ on the rateable value, and £1 15s. 5d. for 850 units used at a half-penny per unit; total electricity cost, £4 12s. 5d. The result of the use of electricity for heating was a reduction of the coal bill from £8 8s. to £4 6s. That saving of £4 2s. deducted from the total electricity cost of £4 12s. 5d. leaves 10s. 5d. only to set against the former gas bill. The amount of the former gas bill is not given, but, of course, could not be anything like so small a figure as the 10s. 5d. The correspondent does not work out the amount which should be added to the electricity cost to represent the annual proportion of the capital outlay, but, on the other hand, he also omits to mention the saving in cost of house decorations by reason of the greater cleanliness of electricity.

Braintree.—Proposed Electric Supply.—The Direct Electrical Supply Co. has informed the U.D.C. that the formation of a company was contemplated with the object of providing a supply of electricity for Braintree and Bocking, and asking the Council if it was prepared to assist and facilitate the scheme. When the matter came before the Council on September 2nd, the chairman said that the Council had decided to keep the matter of electric light in its own hands. He added that a Committee had the question under consideration, and an expert had been appointed to make a report respecting the provision of electricity works. This report, he hoped, would be available within the next month.

Brazil.—The Santos Power Plant.—The Compania Docas de Santos, which in addition to controlling the Docks at the Port of Santos, Brazil, carries on a good deal of building and other work in that city, has recently completed a large electricity station at a place about 37 miles from Santos, where the power of the River Statinga is utilised. The river is located in a very mountainous district, and is stated to have a fall of over 2,000 ft. in a few miles. A canal had first to be constructed to conduct the water to the pipe line; the latter is about 1¼ miles long; it is built up of steel pipes, each section being nearly 20 ft. long. The power station is located on the banks of the river, and owing to the marshy nature of the land, cement foundations to a depth of nearly 60 ft. had to be constructed. The plant at present installed comprises five sets of turbines and 3,000-kw. three-phase generators, working at 2,300 volts, 60 periods, the normal speed being 514 r.p.m.; three sets of turbines and 130-kw. (220-volt) exciters; also transformers, each of 1,000 kw. capacity, arranged in groups of three. The current is transmitted at a pressure of 44,000 volts to Santos, where at the sub-station five 3,000-kw. transformers step-down the current to 6,600 volts. From the sub-station 21 distributing circuits run to different parts of the city—to the docks for power purposes—for the operation of the numerous cranes and conveyors—to the lighting system, and to a quarry owned by the company, the latter absorbing about 650 h.p.

Bridge (Kent).—Electricity Scheme.—The R.D.C. on September 4th received from Mr. G. Stainton, of Whitstable, particulars of the E.L. scheme for Sturry, Fordwick, Westbere and Broad Oak, briefly referred to in a recent issue of the Elec. Rev. Mr. Stainton stated that current would be generated at the Black Mill at Sturry. Water-power would be utilised, and, if necessary, this would be supplemented by a suction gas plant. It was proposed to distribute the current by overhead wires, at about 240 volts, and this would enable the company to provide electricity at a rate sufficiently cheap to compete with both oil and gas. The Council deferred further consideration of the scheme.

Canada.—The *Canadian Electrical News* states that there are no signs of abatement in the demands being made on the Hydro-Electric Commission for extensions of its service. To cope with these the plant of the Niagara Falls transforming station is being increased from 50,000 to 75,000 h.p. A second circuit of aluminium steel-cored cable is being added between Dundas and St. Thomas, and a new double copper circuit line between St. Thomas and Windsor is being built. The Commission's engineers have devised an apparatus for testing insulators in service, which will be continuously used with a view to avoiding breakdowns.

Two 5,000-kw. hydro-electric units are being added to the Winnipeg City plant, also a 9,000-kw. transformer. The present transformer plant is built for 6,000 volts, but future equipment will be for 110,000 volts, and a second transmission line to be erected will consist of steel towers with suspension insulators, and be available for the higher pressure.

The Kaministiquia Power Co. (Fort William) which has a 35,000-h.p. hydro-electric plant, is proposing to bring this up to 50,000 h.p. by the addition of either one or two units.

Carlisle.—E.L. Surplus and Rate Aid.—At a meeting of the T.C. on the 9th inst., there was a discussion with regard to the allocation of the profits of the electrical undertaking. The Electricity Committee recommended that £500 be added to the reserve fund, and that the balance of £1,000 be paid to the City Fund in relief of the rates. Mr. Creighton moved an amendment that the whole of the profits be handed over to the the City Fund, the net profits of the gas works, £6,000, being, in his opinion, sufficient reserve, especially as they could fall back on the City Fund in the event of a deficit. After discussion, the amendment was carried by 19 votes to 11. It was resolved on the recommendation of the Electricity Committee to install a high-tension supply in order to meet the present and future wants of the area, at a cost of £4,300; also to seek the permission of the B. of T. for the scheme.

Ceylon.—The Municipality of Galle has passed a resolution in favour of electric lighting for the town.—*Indian and Eastern Engineer.*

Chile.—A Large Electrolytic Plant.—The Chile Exploration Co., which owns mines at Chuquicamata, has placed an order for a large electric power plant with Messrs. Siemens-Schuckert, for the purpose of delivering current at the mines in order to deal with the extraction of copper by electrolytic methods. The power station is to be placed at Cobija, on the Chilian coast, and the first installation will consist of four turbo-generators of 10,000 kw. each, and a pressure of 5,000 volts. The current will be stepped up to 110,000 volts, and transmitted to the mines at a distance of about 180 km., where it will be stepped down and converted by means of motor-generators, each of 2,500-kw. capacity, to continuous-current at a pressure of from 250 to 190 volts, at which pressure the power will be passed into the baths. The steam

turbines in the power station will be fed from 16 marine-type boilers, the fuel being oil, which will be delivered in bulk direct from the ship into tanks placed above the power station. It is interesting to note that this will be one of the largest installations of its kind in the world.—*Review of the River Plate.*

Continental Notes.—FRANCE.—The Municipal Council of Roubaix has voted a credit of £44,000 for the extension of the municipal electrical installation.

The Ateliers de Construction Electrique du Nord et de l'Est is about to erect a generating station of 15 000 H.P. capacity at Fourthambault in the Department of the Nièvre, with a view to supplying electricity to the factories on the Nièvre and the cement works located in the basin of the Beffes.

RUSSIA.—The municipal and provincial fund recently created by the Russian Government, and actually operative only since the beginning of the present year, has already received from municipalities and provincial councils 128 applications for loans to a total of 23,435,500 roubles. Among towns actually accorded loans are :—Raizan, 1,000,000 roubles for the construction of an electric station and the establishment of a water supply service ; Krasnviarsk, 150,000 roubles for the same objects ; Vero, in Livonia, 30,000 roubles for a generating station.

SPAIN.—A company has just been formed in Madrid with a capital of £45,000 and the title La Sociedad Nuestros Senores del Rosario, to construct a railway and an electricity generating plant in connection with the marble quarries near Macael, in the province of Almeria. Some available water power is to be utilised.

Crewe.—A clause is to be inserted in the draft Omnibus Bill, which is being promoted by the Corporation, to enable the Corporation to sell, let for hire, &c., electrical fittings.

Dewsbury.—The Electricity Committee has decided to adopt for operation, from January 1st next, an alternative tariff for consumers for all purposes of 15 per cent. on the rateable value of the consumer's premises, and ½d. per unit for current consumed, and to reduce the charges for meter hire from 7s. to 5s. per annum.

Doncaster.—The T.C. has decided to apply to the L.G.B. for powers to purchase land adjoining the electricity works in Grey Friars Road for the erection of extensions to the present works.

Ealing.—The B.C. has received the sanction of the L.G.B. to the scheme for extending the Town Hall, which is to provide better accommodation in particular for the electricity department.

Eastbourne.—WORKHOUSE LIGHTING.—The B. of G. has decided to have the electric light installed at the workhouse infirmary, to the specifications of Mr. Brydges, borough electrical engineer. The estimated cost is £84.

Ecuador.—Messrs. J. G. White & Co., of London, are negotiating with the Guayaquil Electric Light and Power Co. regarding an extension of the company's plant.

Gellygaer.—PUBLIC LIGHTING.—The U.D.C. has decided to ask the Merthyr Traction Co. to quote terms for public lighting by electricity at Bedlinog.

Great Harwood.—Upon the question of an electricity supply at Great Harwood, it is reported that Mr. S. J. Watson, borough electrical engineer, Bury, has attended a meeting of the Council and given his views. It is understood that he favoured negotiations with Accrington, with a view to ascertaining the terms on which it would supply current, rather than the erection of a local generating station, providing, of course, that the terms were satisfactory.

Hebburn-on-Tyne.—THE MAINS QUESTION.—At a meeting of the Urban Council, on the 8th inst., a member drew attention to a case of the fusing of electric cables in the vicinity of his residence, which resulted in his room being filled with the smell of bitumen ; his neighbour was awakened, and found that the whole house was filled with the odour. In the shop adjoining the position was worse, and the smell was similar to that referred to at the inquest on the victims of the Lyons Street explosion. These happenings were becoming so frequent that it was high time that the Council took drastic action. The clerk said the B. of T. had decided to hold an inquiry into the Lyons Street affair, and also the system under which the cables were laid in the town, but he understood that inquiry would take place in London. If he were instructed he would ask the B. of T. to state the date of the proposed inquiry, and he suggested that members should supply him with particulars, or be prepared to place particulars before the inquiry. It was decided to write to the Electric Supply Co. and ask for an explanation.

Hetton-le-Hole.—PUBLIC LIGHTING.—The U.D.C. has accepted the tender of the local E.L. company to light public lamps in Houghton Road, from August 10th to May 14th, at £1 8s. 9d. each.

Horsham.—YEAR'S WORKING.—The electricity accounts for the year ended March 31st last, show that after paying interest and principal, there was a profit of £264, as against £434 in the previous year. But for heavy expenses incurred in relaying mains, the profit would have exceeded that of 1912. The undertaking continues to grow, and has well maintained the progress of past years. The number of lamps connected has increased by 2,268 ; this is the biggest increase shown since 1905.

Hyde.—STREET LIGHTING.—An experiment is about to be made by the Lighting Committee with a view to comparing the merits of electricity and gas for street lighting purposes. The Joint Tramways and Electricity Board is being asked to fix three electric lamps in Bennett Street, and the Gas Co. is to supply mantles and fittings for three lamps in the same street, the power to be similar.

Knaresborough.—PROPOSED ELECTRIC SUPPLY.—The U.D.C., last week, adopted a recommendation by the Gas Committee that a hydro-electric plant should be placed on the river Nidd for the purpose of making a commencement of the town's electricity supply. The chairman said the scheme was only a beginning, but if the Council did not make a move, there was little doubt that some private company would do so and leave the authority in the lurch.

Leeds.—SEWAGE PUMPING.—At a meeting of the City Council last week, Mr. T. Oldroyd, moving the minutes of the Sewerage Committee, referred to the pumping plant of the new sewage disposal scheme. He said that three years ago the Committee decided to use electric power for the pumps, but when the tenders were being received, its attention was directed to the Humphrey pump, and the Committee asked for a tender for this pump and thought of recommending the Council to accept it. Upon urgent representations of the Electricity Committee, however, the matter was reconsidered, and the contract had since been placed in accordance with the original intention, and he believed that the terms upon which it was receiving a supply of electrical energy for pumping purposes justified the Committee in its eventual action.

London.—LEWISHAM INFIRMARY LIGHTING.—The Guardians on Monday considered two accounts received from the South Metropolitan Electric Light and Power Co., Ltd., the first amounting to £108 for installing the electric light in the Connaught and Albert wards at the Infirmary. The company had installed the light in order that the Guardians might for themselves decide on the relative merits of electricity and gas for lighting the institution, and after a prolonged trial the Board decided to install the electric light in the infirmary and workhouse. The installation in the other parts of the buildings was given to Mr. J. Hewens, of Lewisham, the lowest tenderer who accepted the work. The account of the company had been considered by the Finance Committee, who recommended that the company be offered £50 in full settlement of the claim in respect of the two wards. This offer had been communicated to the company, who, in a letter to the Board, asked for a reconsideration of the matter, as at the present contract price, the installation in the two wards would amount to £73 10s. ; after discussion, this price was agreed to.

The second account was for £54 for the installation in the medical superintendent's house. Objection was raised to a sum of £9 for nine brass standards, it being maintained by Mr. A. O. Weeks that the standards were included in the contract. It was decided to refer the account back to the Committee for reconsideration.

Maidstone.—The E.L. Committee has introduced a new scale of charges for electric lighting for shops and business premises, as follows : A fixed charge of 8d. per lamp per annum for each 32-watt lamp (25 C.P.) or equivalent, plus 1d. per unit for all energy supplied. An alternative is the M.D. system, with 7d. and 2d. per unit.

Malvern.—There was a profit on the electricity undertaking last year of £47. In the two previous years there was a loss.

Middleton (Lancs.)—The E.L. Committee has given consent to the Lancashire Electric Power Co. supplying Messrs. S. Schwabe & Co., Ltd., with electricity on certain conditions. Councillor Wiggins said the contract between Messrs. Schwabe and the Power Co. was for 10 years, and he took it that the Corporation would not be able to meet the demand before that time.

The report of the auditors to the T.C. shows that during the past financial year capital expenditure amounted to £2,432. There was a loss on the past year's trading amounting (after provision of £500 for depreciation) to £1,800, as compared with £991 for the year ended March 31st, 1912.

New Zealand.—The Dominion Portland Cement Co. has received a licence to generate hydro-electric power at Wairoa Falls, subject to the Whangarei and Dorgaville boroughs being supplied with certain power.

The company has 2,000 acres of limestone country, and is on the eve of calling for tenders for the hydro-electric plant and cement-making machinery required. The falls are expected to give 1,500 H.P. with the natural flow, and this can be increased by damming the river above.

North Wales.—The North Wales Power and Traction Co., Ltd., has applied to the B. of T. for consent to use overhead lines for the transmission of current from Fachell to the Dolgarrog works, and thence to the quarries of Penmaenmawr and the Welsh Granite Co., Ltd., at Penmaenmawr.

Redcar.—At a meeting of the U.D.C. on September 4th, a letter was read from the B. of T. intimating that it was considering the question of revoking the Electric Lighting Order of 1900, held by the Cleveland and Durham County Electric Power

Co., Ltd., owing to the failure of the company to provide a supply. The Council has decided that the general manager of the Electric Power Co. should be interviewed respecting the question.

Redditch.—Suggested Sale of E.L. Undertaking.—Following on a report by the manager, that even with the new turbine plant at the electricity works, a breakdown of the latter would involve failure of supply, a member of the Council, rather than face additional expenditure on plant, gave notice that he would move that the clerk be instructed to call a town's meeting to consider the advisability of selling the undertaking.

St. Anne's.—Loan Sanction, &c.—Sanction has been received for the borrowing of £3,000 for electric mains and services.

Messrs. Taylor & Leigh, the electrical engineer and clerk, have been authorised by the Council to enter into negotiations with Lytham Council with reference to a supply of electricity in bulk to Lytham.

Salford.—Loans, Street Lighting, &c.—An application is to be made for sanction to borrow £2,000 to cover the cost of converting a portion of the bulk supply of three-phase current at 6,600 volts to 3,000 volts two-phase current. The detailed estimate of the cost of the scheme is as follows:—One twin 3,000-volt two-phase switchboard with three transformer panels (one blank) and four-feeder panels on each phase, £1,081; two automatic regulators, £283; replacing old transformers, £300; contingencies, £335. In addition to this, the cost of a two-phase feeder cable from the power station to Cavendish Road transformer pit, Kersal, is given at £2,587, but this latter will be defrayed out of the loan of £21,000 for mains recently sanctioned by the L.G.B.

At the T.C. meeting last week a question was asked as to when the Council might expect the report of the special committee appointed to go into the question of street lighting. Alderman Hulton, who did not give a definite reply, said that when they presented a report they wanted to present one that would be complete, and that would show the alterations and improvements they proposed to make.

Sheffield.—The T.C. announces that current for lighting the outside of business premises is now supplied at 2d. per unit when taken through a separate meter.

Skelton and Brotton.—At a meeting of the U.D.C. on Friday last, it was announced that plans and specifications were being prepared for an electricity scheme to be carried out under the recently obtained prov. order.

South Africa.—The Uitenhage (Cape Province) ratepayers have confirmed the purchase by the Corporation, from the Uitenhage Electric Light and Power Co., of London, of the electric lighting installation for £30,000. Authority was also given to raise the necessary loan to defray the purchase price and incidental expenses.

A further increased demand for electrical cooking appliances is anticipated in Durban, as the municipality is considering a scheme for advancing the money to householders who find the outlay an obstacle. During the past financial year the number of consumers of current for private purposes has advanced from 5,529 to 6,100.—*African World.*

Stockport.—Dealing with the abstract of accounts at the T.C. meeting on September 3rd, the chairman of Finance Committee said the sales of electricity were up by £3,956, which was equal to an increase of 18 per cent. The working expenses were up by £1,896—an increase of only 12¾ per cent.—and the result was highly gratifying.

Stretford.—The question of the supply for tramway purposes in Trafford Park has been adjourned for a couple of months. In the meantime the resident engineer is to draw up a report upon the cost of connecting up the Trafford Park system, and the effect thereof upon the station. Pending the result of the foregoing, the question of extending the plant at the generating station has also been adjourned.

Swansea.—Loan Sanction.—It was reported at last week's meeting of the Electric Lighting and Tramways Committee, that the L.G.B. had sanctioned the borrowing of £40,000 for electrical extensions in the borough. The electrical engineer (Mr. Prusmann) was instructed to prepare specifications and invite tenders for electric motors and switches for periods of one or two years, the existing contracts having almost run out. It was further agreed to purchase from Messrs. Ferranti, Ltd., a switchboard required for temporary use at the electricity station, and eventually for permanent use.

Teignmouth.—Mr. E. M. Lacey has been asked to report on a proposed electricity scheme for the Corporation.

Torpoint.—Public Lighting.—The U.D.C. has decided to adopt electricity for public lighting, and has accepted the terms of the electricity company for 50-c.p. lamps at £2 5s. each per annum.

Winchester.—Loan Sanction.—The T.C. on September 4th received from the L.G.B. sanction to a loan of £1,800 for the purchase of the freehold of the site of the electricity works. It was decided to install a new reversible booster at an estimated cost of £350.

Wolverhampton.—The Water Committee has decided to dismantle the existing plant at Goldthorn Hill station, and to install electrically-driven high-lift centrifugal pumps (in duplicate) at an estimated cost of £630, to be paid for out of reserve fund.

Yorkshire Municipal Extensions.—Large schemes of extensions of area are being entered upon by Leeds, Bradford, Huddersfield and Halifax, which, if carried to success, will involve a very great increase in the possibilities of electrical supply, bringing into the jurisdiction of the authorities named a wide stretch of terrain which has now no such facilities. Leeds proposes an increase of area by 41,441 acres, and Bradford aims at an accretion of 57,482 acres.

TRAMWAY and RAILWAY NOTES.

Ashton.—No Strike.—The difficulty which threatened to bring about a general strike of tramwaymen has now been overcome. There was an insufficient majority of the tramwaymen in favour of a strike, and as a result of a conference, a scale of pay has been drawn up which has now been accepted by both sides.

Argentina.—For year ended June 20th the Compania de Tramways Eléctricos del Sud made a profit of $231,843·90 m/a. The paid-up capital is $3,098,500.—*Review of the River Plate.*

Australia.—The plans for the Sydney tube railway have been approved by the New South Wales Cabinet. The Minister of Works stated that the matter will be submitted to Parliament as early as possible this session, with a view to the work being started without avoidable delay.—*Tenders.*

Bristol.—The Tramways Purchase Report.—At a recent meeting of the Council, a report of the Committee, appointed in February last, to consider as to the desirability or otherwise of exercising the option to purchase the tramway undertaking within the city, was considered. In the Bristol Tramways (Extensions) Act, 1898, provision is made that the Corporation may first give notice to exercise its power to purchase the whole of the undertaking then within the city on May 1st, 1915, or within six months of that date. This power to purchase, if not exercised at the above-mentioned date, or within six months afterwards, will recur at the expiration of every subsequent period of seven years. In its report the Committee states that the option at present extends to about 25 route miles out of a total of 31 route miles of the Bristol Tramways undertaking. Of the remainder, about 1½ miles is purchasable in 1928, and five other short lengths in 1946. After having obtained all the information possible with reference to other tramway undertakings, and with the view of arriving at an approximate valuation of the Bristol Tramway undertaking, the report continues, the Committee obtained the assistance of Mr. J. B. Hamilton, Leeds, and of Mr. J. F. C. Snell. These gentlemen have gone very exhaustively into all the questions referred to them, and have advised as to the probable cost of acquiring the undertaking, and the probable return which would accrue to the Corporation on the capital amount spent in its purchase, and after taking into consideration the past history of the undertaking, and the probabilities for the future both as regards the number of passengers to be carried on the present or an extended system, and the chance of any alteration or improvement in electric or other form of traction which would replace the present system, they have advised that on their estimate the Corporation possesses a very valuable option which it would be advantageous for it to exercise on May 1st, 1915, in the absence of any important or radical changes. Continuing, the Committee states that under the Tramways Act, 1870, the Corporation can acquire the greater portion of the tramways in 1915, but if it so acquires them, power to work them must be obtained by a special Act, and without such power the Corporation is not in an equitable position to enter upon any negotiations with regard to the undertaking. Under the circumstances, therefore, the Committee confidently recommended the Council to promote a Bill in the next Session of Parliament for the necessary powers to work the undertaking if acquired, and also to raise the purchase money to be paid by the Corporation. This recommendation, the Committee stated, did not bind the Council to any definite policy, but left it free to determine, when the proper time arrived, whether it would exercise the option to purchase or not; whilst even if the Council decided not to give notice to purchase the tramway undertaking, the expense of obtaining the powers above mentioned would not be thrown away, inasmuch as the powers when once obtained would remain for all time, and could be put into force should the Council at any further date determine to exercise the option of purchase.

Ald. Pearson moved that a clause be inserted in the proposed Bill enabling the Corporation to take a poll of the city on the question. The Tramway Co. had been approached for information to enable the Committee to value the undertaking upon absolutely reliable information, but the company did not think the time had arrived when it could give the information. The Committee, however, was in possession of certain information which enabled it to provide an estimate. Mr. Witty doubted if the Bill itself was necessary. He declared that the Council had authority to purchase and to work the trams, and that the Bill was not therefore needed. Mr. Moore asked if the Corporation was the authority to grant licences for motor-'buses, and an affirmative reply was given. Ald. Pearson's resolution was in the end carried, with a slight amendment.

(*Continued on page* 423.)

ELECTRICAL INSTALLATION AT A FRENCH IRON WORKS.

By Dr. ALFRED GRADENWITZ.

Among the various groups of metallurgical and other works characteristic of the industrial region of Northern France, those in the district of the River Sambre are amongst the oldest and perhaps the most important—Haumont, Louvroil, Maubeuge, Recquigies, and Jeumont, being names well known in the annals of industry. The position of this area on the boundary of the Charleroi colliery district and only a short distance from the Mons and Valenciennes collieries, as well as the importance of the railways passing through it, are among the principal factors to which its present prosperity is due.

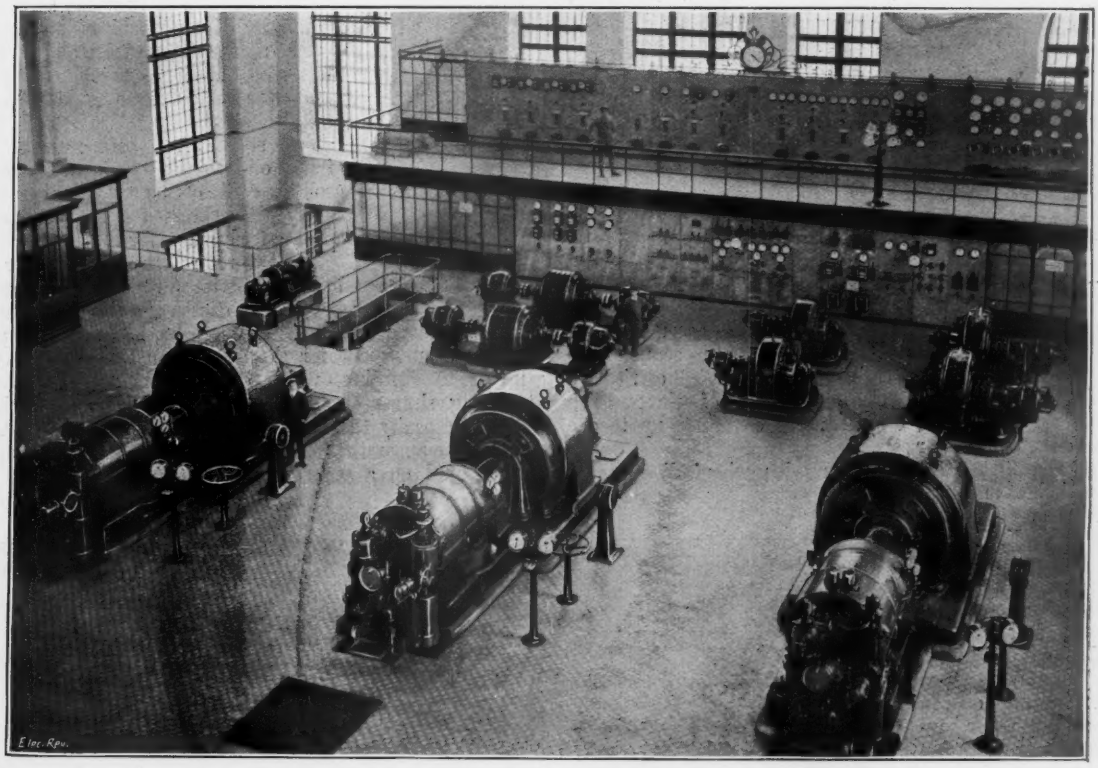
The industry of this district has of late years developed largely, through the creation of a number of new works and extension of many existing ones, practically all of which make great use of electricity for the operation of their various departments.

In the present article it is proposed to describe the electrical installation of the Societé Anonyme des Usines de l'Espérance, of Louvroil, which was supplied and erected by Messrs. Ateliers de Constructions Electriques du Nord et de l'Est, of Jeumont, France.

It may be said that these works are among the oldest of the district. Being situated on the left bank of the Sambre, between the river and the international railway connecting three of the European capitals, they have, by the quality of their products, won a considerable reputation. In addition to two blast furnaces at Aulnoye, the company possess 21 puddling furnaces, six other furnaces, five rolling mills, and an extensive horseshoe factory; the total output of these works during recent years amounted to about 50,000 tons of castings and 60,000 tons of manufactured iron.

The electrical installation comprises a three-phase alternating current power transmission plant (at 3,150 volts, 50 cycles) for feeding sub-stations situated at a considerable distance, the blast furnaces, pumps, &c., and a 550-volt direct-current system for supplying the motors of the cranes and transporters (these being mostly situated only a short distance from the central station, transmission was not expensive); there is also a direct-current three-wire distribution system (2 × 120 volts) for the lighting of the works.

The central power station is situated in the same building as the blowing engines, and comprises:—Three turbo-alternators for 3,150 volts; two static transformers for 3,150/525 volts; four rotary converters for 3,150 volts alternating/550 volts direct-current; two converters for 3,150 volts alternating/2 × 125 volts direct-current; also high-tension main and low-tension auxiliary switchboards.



View in the Power Station of the Soc. Anon. des Usines de l'Espérance.

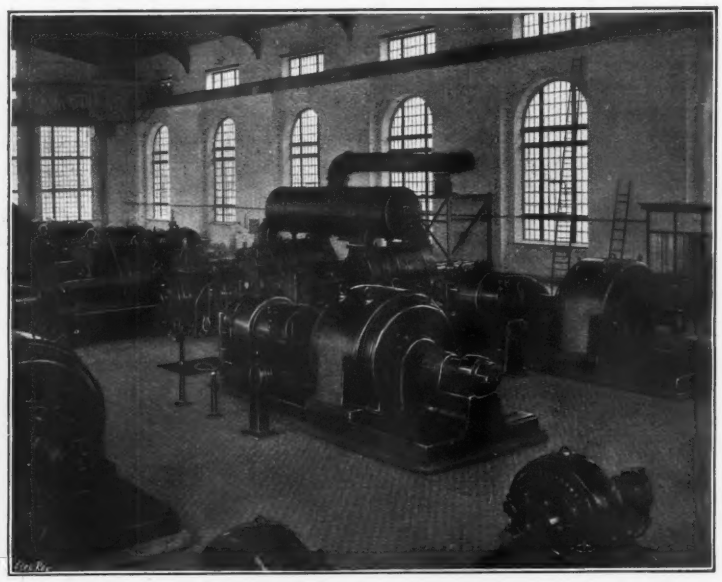
The central station was arranged so as to separate the steam plant well from the electrical machinery.

The whole output of the central station is generated by three turbo-generators, comprising Brown-Boveri-Parsons steam turbines, of 1,200 KW. normal rating, fed with steam superheated to 300° C. at a pressure of 180 lb.; each turbine drives an enclosed alternator provided with forced ventilation, and capable of supplying 1,600 K.V.A. in the form of three-phase current at 3,150 volts and 50 cycles. Each set runs at a speed of 3,000 R.P.M., and carries its own direct-connected exciter, but the machines can be excited from one of the converter sets for the lighting service.

The air for the ventilation of the alternators is drawn from the outside atmosphere through a masonry conduit, and before reaching each alternator passes through a suitable filter; self-acting slides are fitted in the conduits to prevent the hot air and dust from returning into the machines and suction chambers.

Current from each generator is led to the high-tension main switchboard by two three-core armoured cables, generally worked in parallel, each of which is able to ensure the service in case of breakdown of the other.

The high-tension switchgear is subdivided; the service and control switchboard is situated on a platform in the engine room, and armoured concrete compartments contain all the apparatus directly submitted to high-tension. The cubicles are on two floors, the ground floor being set apart for the duplicate bus-bar system and for the coupling and earthing section switches. Each of the bus-bars is carried on porcelain insulators in a special compartment running the whole width of the panels. The bus-bars are connected to the section switches of each panel by cables carried on insulators; each panel comprises a set of three-section switches, which allow the panel to be connected up to one only of the two bus-bar sets.



Interior of Power Station, showing Turbine Plant and Blowing Engines.

On the first floor are arranged mechanically-operated oil switches and the instrument transformers, &c. Each panel is separated from those adjoining it by armoured concrete partitions, and can be readily cut off from the bus-bars, earthed and worked on in safety whenever required. The conductors to each panel are covered with asbestos braiding, and carried on porcelain insulators, any bare portions of the conductors and apparatus being separated from one another by a movable and incombustible insulating partition. Each concrete cubicle corresponds with a switchboard panel carrying measuring and control instruments.

The opening and closing positions of the switches are indicated on the switchboard by the position of the control lever, and checked by signal lamps (green and red) visible from the end of the hall.

All the feeder panels are protected by adjustable time-lag maximum-current relays; the alternators are also protected by time-lag power relays.

The synchronising of the alternators and the rotary converters is centralised on a double-faced column placed on the platform. Instructions to the turbine operator can be given by the switchman through the apparatus on the column which is visible at a distance, or else through apparatus and signal lamps placed beside each set, the signal lamps being controlled from the switchboard.

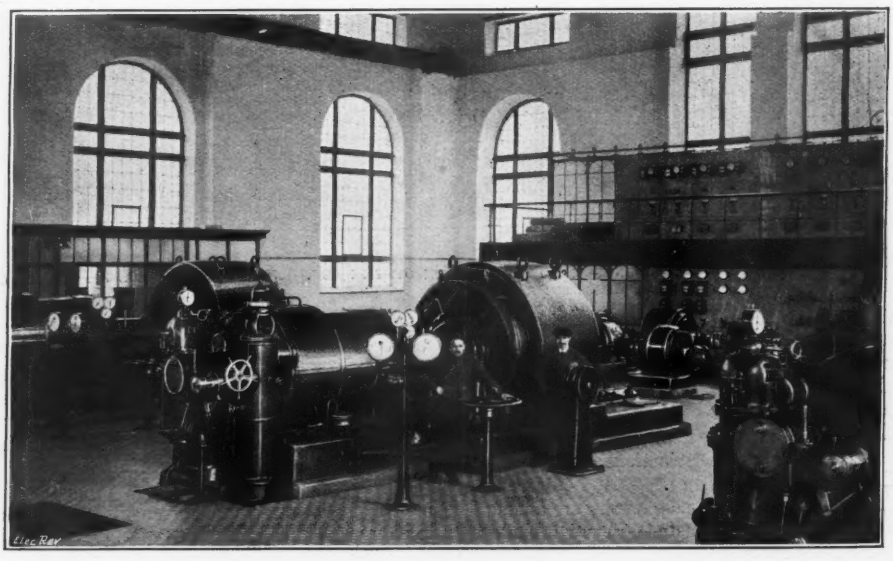
The high-tension A.C. supply is distributed to the converters, transformers, and sub-stations through this switchboard, which comprises a total of 20 panels.

Alternating current is supplied to four, three or six-phase compound rotary converter sets, two of which are of 350 KW. and two of 175 KW. capacity each. Each unit comprises a transformer, a reactance coil, a rotary converter, and a starting motor. The rotary converters are operated at a speed of 750 R.P.M., and supply 550-volt direct-current for the elevators and tractors of the blast furnaces, as well as for all the lifting machinery and transporters at the steel works and rolling mills, where momentary overloads of up to 100 per cent. have to be met without inconvenience.

Two static three-phase transformers of the oil-insulated type, with natural cooling, each of 350 K.V.A. capacity, supply the motors for the condensers and the feed pumps for the boilers.

The two rotary converter sets for the lighting service (arc and incandescent lamps) each consist of a three-phase asynchronous motor (3,150 volts, 50 cycles, 250 H.P.), comprising an arrangement for short-circuiting the slip-rings and lifting the brushes, which operates through half-elastic coupling sleeves two compound-wound dynamos, each of 75-KW. capacity 125 volts pressure, speed about 725 R.P.M.

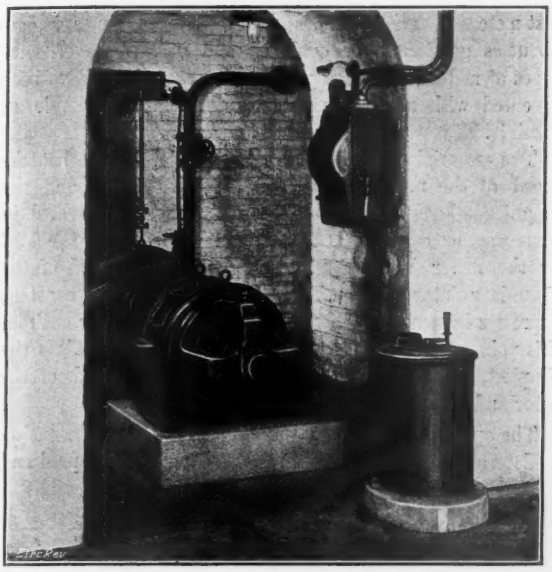
All the apparatus for controlling the low-tension supply is grouped on a series of marble panels placed below the platform in the neighbourhood of the machines to be controlled.



1,200-KW. Turbine Set; Steam End.

The armoured cables for the alternating-current supply had to comply with exacting requirements, particularly as regards their excess pressure capacity was concerned. The 3,000-volt cables were designed for a working pressure of 5,000 volts, and tested for half an hour at 15,000 volts, while those for the 550-volt service were designed for

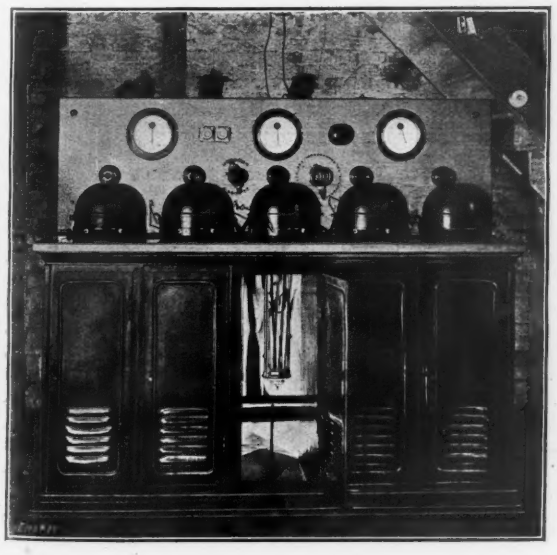
1,000 volts and tested for half an hour at 3,000 volts. Rupture tests made on cable samples showed the pressure limits as a minimum to be 30,000 volts for the 5,000-volt cables, and 9,000 volts for the 1,000-volt cables. Bending and excess voltage tests made after laying the cables gave very satisfactory results. The armoured cables have an aggregate length of about 5 km.



Motor-Driven Pump, &c., for Condensing Plant.

The direct-current conductors are aerial lines connecting the low-tension switchboards, with the roof of the central station.

The most important of the distributing sub-stations is that feeding the steel works and rolling mills, which contains high-tension switchgear feeding a static transformer of the same type as those in the central station, with a ratio of 3,150/525 volts and an output of 350 K.V.A. ; also 525-volt



Testing Board for Arc Lamps.

A.C. switchgear for distributing the supply to two repair shops and some accessory services of the rolling mills. This switchboard has been designed for receiving, in case of emergency, 500-volt three-phase current from the central station, each of its out-going lines being protected by an adjustable overload relay.

A direct-current switchboard distributes energy received direct from the central station through two lines connected in parallel, each of which can maintain the service in the event of accidents. This switchboard has connections for two incoming lines equipped with circuit breakers for isolating automatically any damaged line ; it also controls six out-going lines for the transporting machinery at the steel works and rolling mills, each of which has an adjustable maximum overload circuit-breaker, a single-pole switch and ammeter. A switchboard is also provided for the distribution of 2 × 120-volt current for the arc and incandescent lighting.

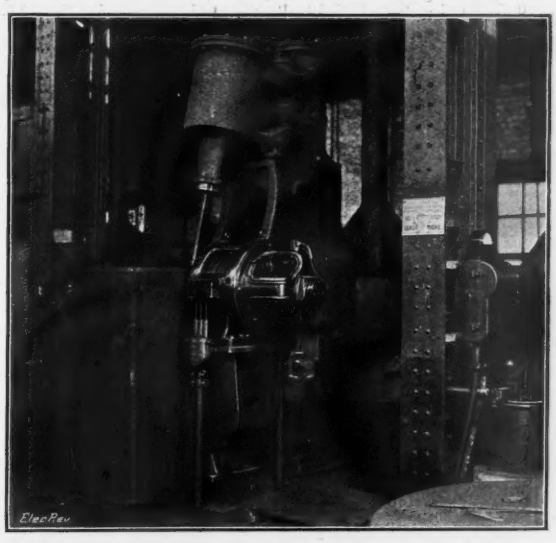
The Societé Anonyme des Usines de l'Espérance has an installation of 13 travelling cranes, five of which were constructed by Messrs. Ateliers de Constructions Electriques du Nord et de l'Est, viz. :—

1. A 25-ton travelling crane in the engine room with a span of 29 m., the three electric motors on which are controlled from a cabin on the crane. The lifting motor is of 35 H.P. and the traversing motors, each 9·5 H.P.

2. A travelling crane for dismounting the blooming rolling mills with a 25-ton lift, and three electric motions.

3. A 15-ton travelling crane for the repairing of casting ladles, having four electric motions controlled from the floor of the factory.

4. A travelling crane in the general repair shop, with a capacity of 15 tons, and three electrical motions.



Electrically-Driven Pneumatic Hammer.

5. A 10-ton travelling crane for the service of the repair shop for the upkeep of the machinery and the handling of converter bottoms in course of repair. The three electric motions are controlled from the floor.

All these cranes have been specially designed for the steel works service, and are equipped with enclosed motors of a type similar to the traction motors of the same company ; all the gearings are enclosed in oil-tight casings.

The installation also includes a number of motors fed by 525 volts, 50 cycles, three-phase current, and an electric testing shop equipped with a testing switchboard having three compartments for 3,150 volts and 525 volts A.C., and 550 volts D.C. respectively.

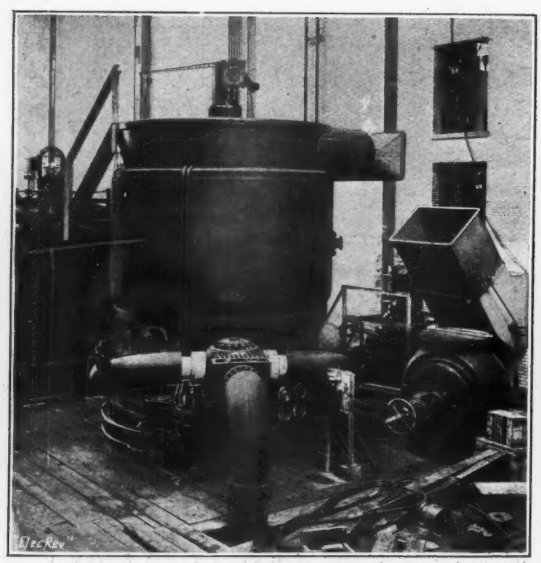
From the foregoing description it will be seen that the electrical installation forms a very important department in a modern iron-works, being indispensable for the supply of light and power ; the day may not be far distant when it will be equally necessary for the refining of the metal. Already the electric steel furnace has made great progress in development, and the facilities which it offers for the production of accurately compounded alloys such as are becoming more and more important to the engineering industry, render it of the greatest assistance to the metallurgist. There is much work to be done in perfecting the construction of the furnace, but many experimenters are engaged upon the problem, and there is little doubt that this application of electric power will, in the future, become at least as important as the functions which it already performs in iron and steel works.

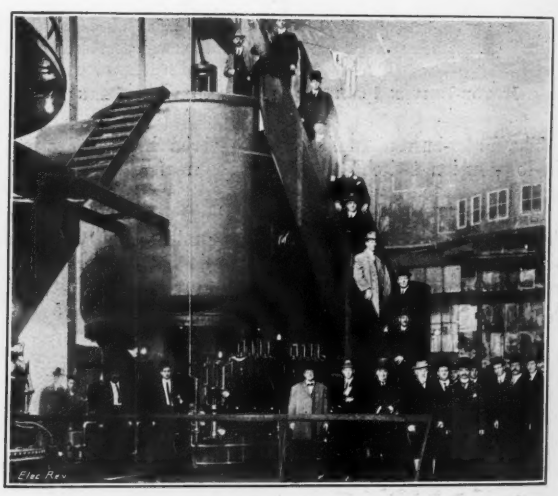
THE NEW YORK EDISON CO.

Probably the largest turbo-generator in the world is that installed at the Waterside station, New York, by the New York Edison Co. Rated at 30,000 h.p., it could supply all the power needed for an average American city of a quarter of a million population.

When this generator was installed at the Waterside plant, it stood alongside seven vertical engines, until then regarded as efficient examples of electrical power plant. These were operating at full capacity, supplying the city needs for light and power; at a signal, one of the seven vertical engines stopped and the new turbine took up the load, and in succession the remaining six engines of the older type were brought to rest, and the new giant assumed the entire load of the seven. Yet the modern turbine plant occupies only a little more space than any one of them.

This latest addition to the Waterside station makes it the world's largest, with a capacity of 500,000 h.p. With an underground system of cables, feeders and mains totalling 1,114 miles, the supply for practically the entire city of New York proper, or Manhattan is furnished, together with the borough of Bronx, comprising a total area of more than 25,000 square miles, densely populated and alive with industry and commerce. This represents more than 100,000 consumers, whose needs are supplied by nearly 4½ million incandescent lamps (4,431,000), more than 40 thousand arc lamps (40,200), and horse-power in motors aggregating 263,500 h.p. To register the energy supplied no fewer than 122,000 meters are required. The plant occupies two full city blocks.





The 30,000-h.p. Curtis Turbine Unit at the Waterside Station of the New York Edison Co.

The history of this company is remarkable in showing continuous service from September 4th, 1882, until the present day, with only 12 hours' total interruption in all that period. The fires of 1883 and of 1890 caused interruptions of three and six hours respectively, and were the only occasions on which complete interruption of service occurred. The growth of the system in that time from an underground main and feeder system of 15 miles, serving a square mile of territory in the heart of New York City to the present immense area covering more than a score of thousand square miles, is a most significant object lesson on the advance of the electrical science in a comparatively brief period.

The electricity supply of New York City and the adjoining area requires in all generating plant of over 700,000 kw. The load factor is 36·9 per cent. and the diversity factor about 7·5 per cent. Tramway supply accounts for half the maximum demand.

METER CONSTANTS.

By "X. Y. Z."

The differences of meaning attaching to the term "testing constant" as applied to electricity meters are a source of considerable inconvenience to those who have to calibrate and test meters of varied types. These differences in meaning are about as great as they could be, and in the case of some types of meters, the testing constants appear to have been invented with a view to making them as unsuitable as possible.

The essential property of an electricity meter is that the speed of the rotor is proportional to the load, and the magnitude known as the testing constant is connected in some way or other with this proportionality. As the load on the meter is represented by the angular speed of the $\frac{1}{10}$-unit pointer spindle, it follows that the testing constant expresses in some way the gearing of the counter. From this point of view the constant "revolutions per unit" is the simplest, expressing as it does the ratio of the speeds of the rotor and the $\frac{1}{10}$-unit spindle.

The operation of taking a revolution test of a meter consists in determining the numerical relation between the speed and the load, and comparing the observed figure with the figure according to which the meter is geared. Generally speaking, some calculation is necessary after each test. The amount of calculation is important in the case of a meter assembled after repair, where the original calibration has been destroyed, and much time can be wasted in this way. Unfortunately, the constant referred to above—revolutions per unit—is about the worst in this respect. In one case, at any rate, calculation can be eliminated, or can be performed mentally, and this is with an ampere-hour meter in which the constant means ampere-seconds per revolution. In this case, if the number of revolutions counted is some simple multiple of the current, the observed constant can be deduced immediately from the reading of the stop-watch. Those who have tested Chamberlain & Hookham or Ferranti direct-current meters know how convenient this method is, and are also probably aware of the annoyance occasioned by having to use a more unsuitable testing constant.

In view of this the writer has found it advisable to convert all testing constants to ampere-seconds per revolution for the testing of quantity meters. When the voltage is under control in the test room, this advantage can be extended to the testing of direct-current energy meters. The formulæ for these conversions are given below for the testing constants usually met with.

Let v be the supply voltage, and K the ampere-seconds per revolution constant required—

(*a*) Watt-hours per revolution. Calling this K_1 ... ... $K=3{,}600\ K_1/v$.

(*b*) Watt-seconds per revolution. Calling this K_2 ... ... $K=K_2/v$.

(*c*) Revolutions per unit. Calling this K_3 ... ... $K=3{,}600{,}000/K_3v$.

(*d*) R.P.M. at full load. Calling this K_4, and full load current C, ... $K=60\ C/K_4$

(*e*) Revolutions per ampere-minute. Calling this K_5 ... ... $K=60/K_5$.

In the case of alternating-current meters, when the power is directly observed in watts, a similar method is applicable by the use of the constant—watt-seconds per revolution, the number of revolutions counted in this instance being a simple fraction of the number of watts passing.

The writer has lately adopted this method in his test-room, and he has found it to be much easier and quicker than the usual system of calculating the different constants from the observed data.

TRAMWAY and RAILWAY NOTES.

(*Continued from page* 418.)

Birmingham.—The Hagley Road tramway was opened for service on September 5th, and the 'bus service withdrawn.

In response to requests it is proposed to introduce some so-called "first-class" cars on this route.

Blackpool.—Year's Working.—The annual report of the Corporation Tramways undertaking states that during the year ending March last the total receipts were £74,166, and the working expenses £39,681, leaving a gross profit of £34,484. Of this £16,152 was required for interest and sinking fund charges, £8,000 for the permanent-way renewal fund, £2,000 for reserve fund, £667 for the rates suspense account, leaving a surplus for the rates of £7,664. During the year £9,987 was spent on the track out of the permanent-way renewal fund, and Mr. Furness, the general manager, states that it is very desirable that a sum of not less than £10,000 be allocated annually to this fund for at least the next five years. The department possesses 78 cars, of which, 20 are of the double staircase type, 15 are vestibule cars, 7 cars-de-luxe (open) and 18 "toast racks." There are 20 passenger shelters. The average number of cars in daily use all the year round was 32, but on August Bank Holiday 72 cars were in service. The circular tour with the additional open type cars, has maintained its popularity, the average receipts per car-mile reaching the high figure of 32·90d.

Bury.—A Corporation tramcar, proceeding to the Rochdale town centre, was badly damaged last week. The controller at the front of the car caught fire, and the flames spread to the other end of the car and also to the upper deck. Fifty or sixty passengers got off the car, and nobody was injured. The flames was put out with sand, and the car was towed back to the depôt.

Canada.—It is understood that the first section of the Edmonton Interurban Electric Railway, which will operate between Edmonton and St. Albert, will be in service within the next few weeks, and cars of the gasoline-electric type will be used.

Continental Notes.—Hungary.—The Hungarian Government has decided that the State Railway authorities shall take a lease for a period of 50 years of the Waitzen-Buda Pesth-Godolloer local electric railway on the payment of an annual rental of £14,583. The Phœbus Electricity Co., which is the other party to the agreement, will continue to supply power for the operation of the line.

Germany.—According to the *Financier*, the Berlin authorities have sanctioned proposals for a suburban electric railway, 6 miles long, with 14 stations, between Gesundbrunnen and Neukolln, to cost 4½ million pounds.

Dewsbury.—New Tramways.—The Corporation has adopted an agreement with the National Electrical Construction Co. to construct tramways to Dewsbury Moor and Shaw Cross, and work them on a lease until 1950, the company to receive a subsidy of £500 per annum for the first five years and not exceeding £250 per annum for the second five years, subject to deductions of any profits made during those periods, and all financial obligations of the Corporation to cease at the end of the 10 years. The Corporation estimates that the sale of electricity to the tramway company will yield an annual profit of £220, the rates payable by the company will be £170, and there will be a saving of £500 per annum in respect to the maintenance of the roads.

Doncaster.—The Tramways Committee has introduced a new car with a Peckham radial truck. The car is fitted with a new form of saloon seat, the invention and patent of the tramways manager, Mr. E. S. Rayner. The seat rests upon legs, and can be tipped back to facilitate the thorough cleaning of the car. It allows more room for passengers' legs and leaves a vacant space for the storage of parcels, &c. The new car accommodates 74 passengers.

Dublin.—According to an Irish correspondent, the tramway strike has "fizzled" out, and the men are returning to their employment. The cars only run during the day; a collection has been voluntarily subscribed for the employés who remained loyal.

The tramway company's receipts have naturally suffered during the week, the falling off being some £3,400—although the aggregate receipts to date are considerably above those of last year.

Fife.—The Wemyss District Tramways Co. is to double the line from Leven to Gallatown, and arrangements have been made for the work to be pushed forward with little delay. Formed about 10 years ago, originally as a private concern, the company has had a flourishing career.

Japan.—The Joto Railway Co. is the name of a new concern which has just been formed in Tokio, with a capital of £100,000 to construct and work an electric railway about 18 miles long, between Yanagishima, Hoiyo and Uraysau, in the province of Chiba.

Leith.—Proposed Tramway Extension.—The Tramways Committee of the T.C. has been instructed to report upon a further extension of the tramway system. The proposed extension is from the present terminus at Seafield to the boundary at Portobello Road. The estimated cost of the proposed works is given as £5,000 for single track, and £8,000 for a double track.

Manchester.—All-Night Cars.—The all-night service of cars was inaugurated on September 3rd. On the first night there was an abnormal rush for the cars, thousands of people having been attracted to the city at a late hour to witness a huge warehouse fire.

The Tramways Committee has decided to accede to the request of the Tramway Workers' Union for an increase of wages for tramway employés. The question of holidays was also considered, the men asking for seven days' vacation instead of six; the Committee referred the matter to the Workmen's Special Committee, with the recommendation that the request be acceded to. The cost of the extra payments to be made, if the consent of the Council is secured, will be about £6,000 a year.

Newcastle-on-Tyne.—In the B. of T. report on the tramway collision which occurred on June 21st last (and was described in detail in our issue of July 11th), Lieut.-Colonel von Donop attributes the accident to the fact that the runaway car had not been taken out of service at once when it was found to be defective; to the omission to apply the hand brake from the rear end of the car when it came to a stand at the top of the incline; and to the want of skill and resource on the part of the fitter, Urwin, who was acting as driver of the runaway car, in the use of his brakes when the car first started away from rest. Colonel von Donop recommends that in view of this accident the Corporation should consider the advisability of fitting the Westinghouse magnetic brakes with the mechanical attachment which allows of the slipper being applied by hand as well as electrically.

Oldham.—Year's Working.—Mr. J. W. Dugdale (general manager) in his just-published annual report on the tramway undertaking, states that the total receipts for the year ending March 25th last were £110,577, and are the largest in the history of the undertaking. The working expenses, including cost of energy, were also larger than ever before, £73,437. The gross profit was £37,140. The number of passengers carried was 21,435,727; the number of miles run 2,045,343, and the average receipts per car-mile 12·57d. The net working expenses per car-mile were 6·084d. on 2,049,916 miles. The total energy used for propelling and lighting the cars and lighting the depôts was 3,435,211 units. The gross capital expenditure on the system up to March 25th last was £442,174, and the Corporation has £76,719 unexhausted borrowing powers. Interest on loans amounted to £11,829, and contributions to sinking fund £3,966, income-tax £1,099, and the rent on leased lines to £5,347. Mr. Dugdale states that the track generally is in a very poor state of repair, and a great amount of work on the track will require to be carried out in the near future.

Salford.—Workmen's Fares.—At a meeting of the T.C. on September 3rd, a long discussion took place on a proposal that workmen's tickets should be issued up to 8 a.m. Ald. Linsley (chairman of the Tramways Committee) opposed the resolution, and said the Committee now had under consideration concessions which would cost £4,000 or £5,000 a year. He did not think they would get extra passengers to balance that. When the 8 o'clock proposal was tried in 1908-9 the receipts dropped £14,000. It was his intention, in considering the proposed concessions, to advise the Committee to do away with workmen's fares altogether. He thought it was time these fares were abolished. It was decided to refer the matter to the Tramways Committee to consider and report to the next meeting of the Council.

Proposed All-Night Cars.—A petition has been prepared for submission to the Tramways Committee urging an all-night service of tramcars in Salford. So far 800 signatures have been obtained, and 1,300 persons have signed a petition for Saturday all-night cars.

Sheffield.—A deputation representing the Sheffield University recently waited upon the Tramway Committee to urge the claims of the University Council for a grant in aid of the

scheme for the extension of the University buildings in Western Bank to meet the increased requirements of the Science and Art Departments. The Tramway Committee has decided that it is for the public benefit of the inhabitants of the city that the application should be complied with, and that it recommends the City Council to make a grant of £1,000 per annum for a period of ten years from the funds of the tramway undertaking.

Stirling.—Proposed Tramways Purchase.—At a special meeting of the T.C. a report with reference to the offer of Mr. George Balfour, London, to purchase the electric light undertaking as a preliminary to the electrification of the tramways, was submitted. The price which Mr. Balfour proposed to pay for the undertaking was the sum which would relieve the Corporation from all outstanding indebtedness. The unredeemed debt at May 15th, 1913, was £28,642. The capital sums spent by the Council on the undertaking up to May 15th, 1913, amounted to £43,284. During the earlier years of the undertaking there were debit balances which were paid out of the rates between 1900 and 1908, the amount being £4,382. Since 1909 credit balances of £2,129 have been carried to the reserve fund. After discussion, it was agreed to forward a copy of the report to Mr. Balfour, and to request him to submit to the Council details of his offer.

U.S.A.—New Single-Phase Railway.—The Norfolk and Western Railway, which serves the coalfields of West Virginia, has contracted with the Westinghouse Co. to equip its Bluefield-Vivian section—some 85 miles in length—on the single-phase system. The contract calls for 26 130-ton single-phase-two-phase locomotives, together with power station and transmission apparatus. Single-phase A.C., at 11,000 volts and 25 cycles, will be supplied to the locomotives by an overhead trolley line, identical with that used on the New Haven electrified sections. The coal trains to be hauled weigh up to 3,250 tons each, and at present require three powerful Mallet steam locomotives to haul and push them over the gradients. Two electric locomotives are to do the same service at double the present speeds. These will be built for running speeds of 7, 14 and 26 miles an hour, and will be supplied with energy from a 27,000-KW. turbine station. Work is to be begun at once, and completed in the summer of 1914.

Warrington.—The tramways manager has been authorised to advertise for the supply of two additional motor-'buses similar in construction to those already in use.

Wigan.—Alderman Ashton, speaking at the Council meeting on September 3rd, remarked that the Sub-Committee appointed to deal with the purchase of new cars hoped to be in a position before the next meeting to recommend the class of car which would be most suitable for the Wigan tramways. The members had visited Bolton, and there seen a car which they regarded as suitable for their purpose, and with some slight alterations and modification he thought it might be adopted for Wigan.

York.—Tramway Extensions.—The proposals of the Tramways Committee for an extension of the present system, and the provision of railless cars to Heworth and along the Huntingdon Road, have been referred back by the Council for further consideration.

TELEGRAPH and TELEPHONE NOTES.

Argentina.—The Deputies have approved a Bill regulating the wireless telegraph service within the country. It provides that the wireless service within the territory of the nation and for international communications up to a distance of 1,000 kilometres shall be carried out exclusively by the State, Government to provide for the erection of the necessary wireless stations, which are to be constructed in such a manner that a vessel navigating the coast and rivers can always be in communication with a station. The sum of $400,000 is provided for this work. The use of this service is declared obligatory on all vessels entering or leaving Argentine ports with 50 or more persons on board, including crew and passengers. The wireless stations are to be capable of transmitting messages a distance of 200 kilometres along the rivers and 5,000 kilometres at sea.—*Review of the River Plate.*

Australia. — The Commonwealth wireless station at Esperance (W.A.), the 12th of the coastal series of Australia, was opened for business in July. Applications are invited for the positions of officers in charge at 12 stations. The salary in each instance ranges between £216 and £240 per annum.—*A.M.S.*

Barbados.—The Secretary of State for the Colonies has sanctioned the acceptance by the local government of the tender of the Anglo-French Wireless Co., for the erection of a station at Bridgetown.

Belgian-Swiss Telephone Service. — A Convention between Belgium, France and Switzerland is about to be signed for the establishment of telephonic communication between Belgium and Switzerland.

Birmingham.—An all-electric power signalling apparatus has been installed at the south box at Snow Hill Station, Birmingham. The instruments are similar to those fitted recently in the north box. The signal motor circuits are not controlled by being led through the facing-point detectors on the ground, as was done at the north box, but by means of route switch contacts in the signal box itself. The route switches are actuated by control magnets, which are energised by the return indications from the points. In order to show the signalman visually the position of each of the points under his control, a small indicator is provided on the locking frame behind each point lever. Track circuits will be provided on all the four main lines through the station and control the stop signals in each direction, so that it will be impossible for a signalman to lower a signal for a train to proceed over a certain road if another train is in possession.—*Birmingham Daily Post.*

Discontent in the Telegraph Service.—It is alleged by the *Matin* that the reason for serious telegraphic delays which have occurred during the past few weeks between England and France is that the British telegraphists are systematically indulging in a novel form of partial strike. In the middle of the transmission of telegrams to Paris the line suddenly appears to become interrupted, and no sooner have the operators at the Paris end got their instruments ready to correct the apparent fault, than the line resumes work as if nothing had happened. This intermittent stoppage of the London telegraphs has resulted in delays of many hours frequently occurring in the transmission of messages between the two countries. The reason for the adoption of this policy is said to be discontent in the British Post Office owing to the recent refusal of the Postmaster-General to increase wages, and also the new modification of the telegraphists' hours of service.

The report has been flatly denied by the Deputy Comptroller of the Telegraph Department, who states that there is no discontent in connection with the Anglo-French service.

Meetings of telegraphists have been held at various provincial centres recently to consider the report of the Holt Committee on postal servants' wages, which has been severely criticised. A special conference on the subject is to be held at Liverpool.

Germany.—The Supplementary Budget for 1913 contains an appropriation of £7,500 for the improvement of wireless communication between Dune and Nola, in the German Colony of New Kamerun.

A flash light for the convenience of flying machines has been installed by the Telefunken Gesellschaft at the Nauen wireless station, at the instance of the German military authorities. The light is of 2,000 C.P., and burns from dusk to dawn. The light-flashes are emitted continuously in the rhythm of the Morse code letter "N," to indicate to aviators the place of origin. Tests made by means of a balloon showed that the light was visible to a distance of 24 miles.

Italy.—Messrs. Franco Tosi & Co., of Legnano, have taken up the construction of Diesel engines. Among the contracts at present in hand are four 225-H.P. four-cycle engines, which are being constructed to the order of Messrs. Fraser & Chalmers for radio-telegraph stations in Canada and Ireland, for the Universal Radio Syndicate, Ltd., London.

Marconi Strike.—The Italian operators of the Marconi wireless installations on board steamers at Genoa, not having obtained from the company the concessions for which they asked, have struck. They have sent messages to Paris, Liverpool, New York, and other centres, asking for the support of their colleagues.

New French Cable Steamers.—The Minister of Post and Telegraphs has just submitted a scheme to the French Senate for the acquisition of two new cable-laying steamers for use in connection with the maintenance of submarine cables. One of the new vessels will be of large size and will be stationed at La Seyne; the other will be a smaller vessel and will be attached to the port of Havre. The French Government has at present only one cable-laying steamer, which is to be sent to Dakar.

Sheffield.—The Watch Committee has decided to install the Stuart & Moore system of telephonic street alarms (consisting of alarms for fire, police and ambulance) at fifty points in the city.

Telegraph Rates.—The rates for ordinary and deferred telegrams to most places in the Belgian Congo are now 4s. 9d. and 2s. 4½d. respectively. Ordinary rates for telegrams to French Equatorial Africa now vary between 4s. 3d. and 4s. 8d. and the deferred rates between 2s. 1½d. and 2s. 4d. The rate for telegrams to Colombia has been increased from 3s. to 3s. 5d. per word.

Telephone Corruption.—Five telephone girls in Paris have been accused of being in the pay for some time past of a corn broker, giving him communication to the detriment of other subscribers, and cutting off certain rivals from all communication with the Corn Exchange when operations were in full swing. The operators also allowed their client to tap the conversations of his rivals with the chief corn dealers. A special call warned him when the line was switched on, and all he had to do was to listen. In return for these services the broker made the girls presents of money.

Later reports indicate that the scandal is more serious and of wider extent than had been supposed; the communications of M. Bloch-David, the principal French operator on the Corn Exchange, had been hampered by preventing him from getting through, and other speculators had been enabled to listen on his line, so as to obtain information as to his proceedings. Apparently these practices have been going on for several years, and numerous complaints have been lodged, but have been disregarded by the authorities.

Telephony in Mines.—An installation of "wireless" telephony has been put down at Dinnington Main Colliery, apparently on the system described in our issue of April 4th, 1913.

Telewriter Exchanges.—The National Telewriter Co., Ltd., has opened a telewriter exchange in Liverpool, and nearly 100 subscribers have been enrolled. Hitherto the company's operations have been confined to London.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—September 30th. Insulators at Sydney, Melbourne, Brisbane, Adelaide, Perth and Hobart.

PERTH.—November 12th. For the P.M.G. Lamp signalling trunk line switchboard, of five sections, &c.

NEW SOUTH WALES.—October 15th. The Government Railways invite tenders for the supply of 13 D.C. motors, to specification No. 412. Specifications are obtainable at the Electrical Engineer's Office, 61, Hunter Street, Sydney (price 2s. 6d. each).

SYDNEY.—October 15th. For the P.M.G.; measuring instruments, telephone parts and switchboard parts. Particulars from the Commonwealth Office, 72, Victoria Street, S.W.

VICTORIA.—November 12th. For the Victorian Railways; flame arc lamps.

MELBOURNE.—September 16th. For the P.M.G.; a common-battery or an automatic switchboard.

September 16th.—Corporation. 176 yd. 0·25 sq. in. three-core lead-covered cable; 5,471 yd. 0·15 ditto, and 3,500 yd. ·05 ditto. Also three 250-K.V.A. three-phase transformers. See "Official Notices" August 29th.

September 23rd.—Sulphate of copper, for the P.M.G. Specifications from the Commonwealth Office, 72, Victoria Street, S.W.

October 14th.—For the P.M.G. A common-battery multiple switchboard.

October 14th.—For the P.M.G. Cable boxes (Sch. 877). See *Commonwealth Gazette*, August 2nd.

November 4th.—For the P.M.G. Eight automatic telephone switchboards.

September 23rd.—P.M.G.'s Department. General stores for a period of two years, as per Schedule 913.—*Tenders.*

November 15th.—Melbourne Suburban Railways. Overhead electrical equipment of permanent way and overhead transmission mains. See "Official Notices" to-day.

October 1st.—Victorian Railways Department. State coal mines, Wonthaggi. Supply of rope road haulage engine and electrical equipment for M'Bride Tunnel, P.D., £15. Particulars at the Melbourne office, Robb's Buildings, Collins Street.

SOUTH AUSTRALIA.—November 12th. For the P.M.G. One lamp signalling switchboard of five sections, one cable turning section and one cable storing section, one two-position recording desk, and one chief operator's desk (Spec. 432, Sch. 296).

September 15th.—Home Affairs Department. Canberra power plant. (Sec. 1) Main power house switchgear; (Sec. 2) switchgear for Diesel engine plant. (Time extended from September 1st.)

ADELAIDE.—November 12th. Postmaster-General's Department. Lamp-signalling trunk line switchboard. See "Official Notices" to-day.

Austria.—September 29th. The Königliche Lagernhausern authorities in Trieste are inviting tenders for the supply of a large floating electrically-operated crane, complete with Diesel engine generating plant.

September 26th.—The Austrian State Railway authorities in Stanislau are inviting tenders for an installation of electric lighting at the railway works in that town.

SERAJEVO.—October 1st. Tenders are required by the Direction of the Bosnia and Herzegovina Railway for the supply of a year's requirements of lighting material, &c. Particulars will be forwarded on receipt of 20 pfennigs postage.

Belgium.—September 17th. Supply and erection of a 25-ton crane, with electric motor and accessories, at the Malines central machine shops. Deposit 1,700 fr. (Cahier des Charges Special No. 1,410 gratis); plan, 0·90 fr. It is advisable to send in tenders by September 13th. Salle de la Madeleine, Brussels.

Bingley.—September 15th. Corporation. Sec. A.—Rotary converters and transformers. Sec. B.—A.C., E.H.T. and L.T. and D.C. switchgear. Sec. C.—Low-tension cables. See "Official Notices" September 5th.

Burnley.—September 22nd. The Guardians of the Burnley Union invite half-yearly tenders for the supply of electrical requirements.

Canada.—October 1st. Regina City Commissioners require tenders for coal bunkers, ash hoppers, coal and ash conveyors and crushers. Deposit with tender. Specifications, Mr. E. W. Bull, Superintendent of Light and Power, Regina.

Dartford.—September 16th. U.D.C. (*a*) Water-tube boiler, economiser, fan, steel chimney and accessories; (*b*) inverted rotaries, transformers, switchboard and cabling. See "Official Notices" August 29th.

Douglas (I.O.M.).—September 15th. Good steam coa (about 521 tons), for the Tramway Department of the T.C. Mr. A. Robertson, Town Clerk.

Eastbourne.—Electric light installation at the Workhouse Infirmary, for the B. of G. Mr. A. Hurst, Clerk.

Egypt.—October 31st. Ministry of the Interior. Tenders for the installation of the electric light at Damanhur.—*African Engineering.*

Germany.—September 20th. The Prussian State Railway authorities at Konigsberg are inviting tenders for the supply and erection of several electrically-operated high-pressure pumps.

September 22nd.—The Baden State Railway authorities in Carlsruhe are inviting tenders for the supply of from 80,000 to 100,000 metres of electric cable.

Greece.—September 30th. The Harbour Authorities at the Piræus are inviting tenders for the supply and erection of two electrically-operated cranes, one of 10 tons and one of 5 tons capacity.

Hoylake and West Kirby.—Corporation. Steam and exhaust piping. See "Official Notices" to-day.

Ilkley.—October 6th. (Sec. 1) Prime movers; (2) station equipment; (3) cables and distribution; (4) overhead travelling crane. See "Official Notices" to-day.

Leicester.—September 30th. (*a*) One high-pressure steam turbine, direct-coupled to one 3,000-KW. three-phase alternator, together with condensing plant, high and low-tension switchboards, rotary converters, &c.; (*b*) two water-tube boilers, together with fuel economiser, and the necessary steam, feed, blow-off and drain pipes, &c. See "Official Notices" September 5th.

Liverpool.—September 16th. Electric supplies for a year to the Mill Road Infirmary, for the West Derby B. of G. Mr. H. P. Cleaver, Clerk, Brougham Terrace.

London.—HAMMERSMITH.—September 24th. Borough Council. Underground cables, and sub-station switchgear. See "Official Notices" August 29th.

HAMMERSMITH.—September 24th. Corporation. One 125-H.P. alternating-current motor. See "Official Notices" to-day.

BERMONDSEY.—October 23rd. Water softener and purifying plant at the Infirmary, Lower Road, Rotherhithe, S.E. Mr. E. Pitts Fenton, Clerk.

Madeira.—With a view to rendering more accessible the interior of the island, the authorities propose to construct a network of railways, which will be worked mainly by electricity. The construction of a generating station is also contemplated. Public tenders for the works will shortly be invited. Those intending to compete would do well to send a technical expert for a preliminary inspection of the circumstances of the several localities.

New Zealand.—November 12th. Dunedin City Council. Supply of meters, demand indicators, insulated and bare wire for two years. Specifications from Electrical Engineer, Dunedin.

Tenders are also asked for the supply of two A.C. pressure regulators for 3,000 and 400 volts. British manufacturers can obtain particulars at the B. of T. Commercial Intelligence Department.

Oldham.—September 17th. Steam coal for the Electricity Committee for three, six or 12 months, commencing October 1st. Specifications and forms of tender obtainable from Mr. S. W. Newington, Electricity Offices.

Orsett (Essex).—September 18th. Provision of communication bells and telephones and repairs to existing bells and telephones at the Workhouse, for B. of G. Mr. E. W. Wilson, the Workhouse, Orsett.

Roumania.—September 17th. Lighting of the city of Tetuci with electricity, and construction of a generating station. Provisional deposit 25,000 fr. Offers to the municipality.

The municipal authorities of Constantza have just invited tenders for the concession for the electric lighting of the town and suburbs.

Spain.—September 21st. The municipal authorities of Saldana (province of Palencia) are inviting tenders for the concession for the electric lighting of the town during a period of 10 years.

September 28th.—The municipal authorities of Riaja are inviting tenders for the concession for the electric lighting of the town during a period of six years.

Tunbridge Wells.—September 13th. Corporation. Supply and delivery during the ensuing 12 months of high and low-tension cables. Specifications and forms of tender from the Borough Electrical Engineer, Stanley Road, Tunbridge Wells.

Turkey.—Supply of 21,500 insulators with curved iron fitments, 1,350 ordinary iron telegraph posts, 150 iron telegraph posts 6 m. long, 150,000 kg. galvanised iron wire, diameter 2 mm. Imperial Ottoman Post and Telegraph Administration, Constantinople.

Uganda.—December 31st. Electric light and power supply for 10 years at Kampala and district, including 300 32-C.P. street lamps and 200 16-C.P. lamps in Government quarters. Uganda Public Works Department, Entebbe.—*Brit. S.A. Export Gazette.*

Wigan.—September 20th. Corporation. 1,500-KW. turbo-alternator, ejector condenser, pipework, and all accessories. See "Official Notices" September 5th.

Worthing.—September 29th. Corporation. Supply, delivery and erection of Diesel engine and D.C. generator. See "Official Notices" to-day.

CLOSED.

Australia.—VICTORIA.—Wycheproof Shire Council. Tenders for electric supply plant have been accepted as follows:—

Dynamo and direct-coupled booster-generator and spares, complete switchboard equipment, and erection of electrical equipment.—Australian Metal Co., Ltd.
Hart accumulator.—Edison & Swan United Electric Light Co.
Meters.—Warburton Franki, Ltd.
Aluminium wire.—British Insulated and Helsby Cables, Ltd.

Tenders.

TASMANIA.—The P.M.G. has accepted the tenders of Messrs. T. Zwicker & Co. and Messrs. Bullers, Ltd., for insulators, and that of Messrs. R. Johnson, Clapham & Morris for 20 tons of copper wire.

NEW SOUTH WALES.—The P.M.G. has accepted tenders for copper binders, copper and zinc battery plates, &c., from the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.; copper tapes and wire, British Insulated and Helsby Cables, Ltd.; copper wire, R. Johnson, Clapham & Morris, Ltd., Noyes Bros. (Sydney), Ltd., and W. T. Henley's Telegraph Works Co., Ltd.; glass cells, R. J. Connolly; brass connectors, British General Electric Co., Ltd; battery parts, &c., Lawrence & Hanson Electrical Co., Ltd.; battery materials, &c., Theodore Zwicker & Co.; Morse inkers, Siemens Bros. Dynamo Works, Ltd.

Bispham.—The U.D.C. has accepted the tender of the Premier Accumulator Co., Ltd., for the new battery.

Bournemouth.—The T.C. has accepted the tender of Messrs. W. Griffiths & Co. for the reconstruction of the permanent way of the tramways in Wimborne Road and Charminster Road and at Poole, at £14,621. The Council has also accepted an amended tender from Messrs. Walter Scott, Ltd., for tramway rails and fastenings, at £6,067, this being due to extra rails being needed.

Bradford.—The Electricity Committee has accepted the tender of Messrs. Holden & Brooke, Ltd., for the supply of a vertical-spindle centrifugal pump, with motor and switchgear, for the Valley Road works, for £119.

Bristol.—The City Council has entered into a contract with the Bedminster, Easton and Parkfield Collieries, Ltd., for an annual supply of coal to the Avonbank electricity works. The value of the contract is estimated at £16,675.

Burnley.—The Electricity Committee has accepted the tenders of the British Insulated and Helsby Cables, Ltd., to supply 1,000 yds. of 1-in. and 500 yds. of ·05-in. lead-covered cable. The British Thomson-Houston Co. has been awarded the contract for the supply of further standard sizes of electric motors required during the period ending March, 1914.

Doncaster.—The tender of Messrs. Crompton & Co. for the supply of feeder panels has been accepted by the Electricity Committee.

Glasgow.—The T.C.'s Committee on Tramways recommend acceptance of the following tenders:—

Sheet mica.—Micanite and Insulators Co., Ltd.
Armature binding wire.—W. N. Brunton & Sons.
Scrap.—Zinc, lead-covered cable, brass turnings and borings, brass dust, copper and mica turnings, dry cells.—John Jackson & Co.
Scrap.—Lead, brass, copper, motor field coils, armature coils.—P. & W. MacLellan, Ltd.
Scrap vulcanised rubber cable.—Ballardie, Holden & Co.
Scrap rubber and motor tires.—City Waste India-Rubber Co.
Scrap old bagging.—George Cunningham.
Altering superheaters, Pinkston power station.—Babcock & Wilcox, Ltd.

The Telephone, Lighting and Power Co., Glasgow, has secured the renewal for a year of the contract for the upkeep of the private telephones in Shieldhall Hospital.

The electrical engineer to the T.C. is to put up signalling apparatus in the new pavilions at Ruchill Hospital, at an estimated cost of £32.

Dundee.—A contract for converting machinery has been placed with Messrs. Bruce Peebles & Co., Ltd., Edinburgh, at £1,500, and the British Insulated and Helsby Cables, Ltd., has secured the cable contract.

Heywood.—The Education Committee has accepted the tender of Mr. Charles Booth for the electric lighting of the Central Council School.

Liverpool.—The tender of the Northern Electrical and Ventilating Co., Ltd., has been accepted by the City Council, at £31, for automatic indicators for the fire-alarm systems at the City Hospital North.

Manchester.—The Corporation Electricity Committee has accepted the following tenders:—

Water-softening plant at Stuart Street station.—Kennicott Water Softener Co., Ltd.
Construction of new meter repair workshop at the Polygon Stores.—Messrs. J. Gerrard & Sons, Ltd.
Supply, delivery and erection of hoist gear, motor and cage, for the new meter repair workshop.—Messrs. Etchells, Congdon & Muir, Ltd.
Supplies of cable.—Messrs. W. T. Henley's Telegraph Works Co., Ltd. Messrs. Callender's Cable and Construction Co., Ltd.; and Messrs. Johnson & Phillips.

New Zealand.—The Waverley Town Board has accepted tenders, approximating to £8,500, for water and lighting works. Amongst the successful tenderers were Messrs. Turnbull & Jones, Wellington, for the hydro-electric pumping and lighting plant, £3,514.

Sheffield.—The following tenders have been accepted by the City Council:—

Stuart & Moore.—Installation of 50 patent telephonic street alarms, £4,097.
Blasberg Engineering Co., Ltd.—Two natural-draught cooling towers, complete with pumps, pipes, &c., £8,779.
Royce, Ltd.—Three electric capstans, fairleads, ropes, motors, &c., £1,128.
C. Bushby & Sons.—Excavations and concrete work for cooling towers, £3,515.

The Council's contract with the Automatic Ticket Printing Co., Ltd., for the supply of tram tickets, is to be continued for a term of five years from April 1st, 1911.

South Africa.—The A.E.G. Electrical Co. of South Africa, Ltd., is the successful tenderer for the entire installation of power house equipment required by the Stellenbosch municipality for the new lighting scheme.

Messrs. Hubert Davies & Co., Johannesburg, have received a contract from the Durban Town Council for 1,000 electricity meters.

Stretford.—The tender of Messrs. Bertram Thomas has been accepted, at £127, for altering the switchboard.

Winchester.—The T.C., on September 4th, accepted the tender of the Tudor Accumulator Co. for the maintenance of a 206-cell battery for 10 years, at £86 per annum.

FORTHCOMING EVENTS.

British Association.—September 10th to 17th. Meeting at Birmingham.

Junior Institution of Engineers.—Saturday, Sept. 13th. At 10.30 a.m Visit to the works of Messrs. R. Waygood & Co., Ltd., Falmouth Road London, S.E.

Salford Technical and Engineering Association.—Saturday, September 20th. At 7 p.m. Lecture on "Grinding Wheels, Grinding Machines, Grinding," by K. D. Morgan.

Municipal Tramways Conference.—September 23rd to 26th. Meeting at Sheffield (particulars on page 427).

NOTES.

The Aisgill Accident.—Mr. Paget, the general superintendent of the Midland line, is not, we think, doing his company any good by airing his opinions, as may be gathered from a statement reported to have been made by him to the *Daily Mail*.

"In my opinion," he said, "the coaches would have been gutted in any case. The pressure of gas would certainly cause the fire to burn more furiously, but I am sure that the fire was not due to the spontaneous combustion of the gas . . . . . The intense heat of a piece of coal from the engine fire would be sufficient to set a light to the woodwork, which would blaze up like a bonfire."

Now, Mr. Paget was present at the inquiry held by Major Pringle at Leeds, and below we give the *Times* report as to the origin of the fire. Driver Caudell, in the course of his examination, said:—

"One of the carriages was partly under the engine and partly under the tender. He left the foot-plate a minute or two after the collision, and fire seemed then to be coming from the carriages. The engine was surrounded on all sides by splinters of wood. He noticed that there were some of these burning between the level of the foot-plate and the ground. He could not say what started it. Something might have been thrown out of the ash-pan. Nothing was thrown out of the smoke-box. He shut the regulator altogether. Nothing would come out if the blast was off.

"The Inspector: Do you agree, Mr. Paget?

"Mr. Paget: It depends. Something might come out. (To the witness.) Supposing there was a tremendous blow, that would shake up the ashes in the smoke-box. In your opinion would the blow be strong enough to blow these ashes upward?—The witness: I do not think so; a The blast was closed by the force of the regu-

lator, and I do not think the blow would send the ash out of the smoke-box. I do not think much came out of the ash-pan.

"Was not fire thrown out anywhere?—No. The fire was all in the box. It shook forward a bit. There was no fire thrown out on the foot-plate.

"So that, if the fire started from the engine, it must have been either stuff thrown out from the ash-pan, or possibly some fine ash blown out of the smoke-box?—There is nothing else for it that I know of.

The witness proceeded to explain that there was timber lying all round the engine. It was piled up as high as the top of the chimney. There was also a very slight fire, possibly a gas fire, amongst some *débris* on the line a few yards in front of the right-hand corner of the engine-cab.

A Small Fire Left Burning.

"Do you think it was a gas-jet?—I thought it looked like a gas fire, but I cannot say. I did not take particular notice of it.

"Did not you think it was important to put this out immediately?—I thought the passengers were more important than quelling the small flames that I saw.

"Did you use any water subsequently to try to put this fire out?—Yes; water from the tender with my own bucket, and then I fetched buckets out of the van.

"Was it when the fire began to increase in size that they began to work at it?—When I first saw the fire I thought we could put it out after we had seen to the passengers. The fire increased so rapidly that I found that that was a mistake. It grew to such a size, and so rapidly, that they were not able to cope with it."

There is nothing in Caudell's evidence to support Mr. Paget's opinion. The fire was all in the box, just as anybody conversant with the construction of a locomotive firebox would expect it to be. No fire was thrown out anywhere, and so far as we are aware it has not been suggested that the gas became alight spontaneously. But, if a piece of coal from the engine fire, assuming it to have been thrown out, is sufficient to set light to a Midland carriage, which would blaze up like a bonfire, a new and hitherto undreamt-of danger threatens travellers on that picturesque route. The company must not only substitute electricity for lighting, *and cooking*, but steel carriages must take the place of the present wooden rolling stock. A telegram from New York, on the 9th inst., describing the smash-up of an express on the Pennsylvania Railway, affords a vivid contrast with the previous terrible disaster on the Newhaven Railway at Wallingford, and attributes the comparative immunity from serious injury of the 70 odd passengers in the express to the fact that all the cars involved were made of steel, while those demolished in the Wallingford accident were constructed of wood.

Even though the cause of the fire which followed the above accident has not been *officially* determined, we are somewhat astonished to read in our contemporary, *The Railway Gazette*, that "A point worthy to be remembered is that it is definitely stated by eye witnesses that the fire broke out as a result of live coals from the firebox, and that, therefore, the question of gas lighting or electric lighting does not arise"; and, again, in *The Engineer*, "we know that the wreckage caught fire . . . . but we do not know that gas was responsible; *indeed what evidence there is points the other way.*" We should have thought that the evidence given at this and previous accidents where gas-lighted coaches have been wrecked and subsequently burnt would have carried a certain amount of conviction even to our contemporaries.

Street Lighting.—The two following resolutions, passed at the Third International Road Congress, held in London a short while ago, are to be submitted to the next meeting of the Metropolitan Paving Committee:—(1) For the purposes of a general determination of methods of lighting, highways may conveniently be divided into three classes, as follows:—(*a*) Important streets in cities, towns or other urban areas in which the traffic after dark is considerable in volume, (*b*) important suburban roads in the vicinity of large towns, (*c*) rural roads in open country, and having regard to modern conditions of traffic, it is essential that adequate lighting by means of fixed lights should be provided in classes (*a*) and (*b*). (2) As a general principle in the lighting of all highways which require to be lighted by means of fixed lights, the method of lighting to be adopted should be such as will provide an illumination as uniform from glare as possible. The amount of illumination and the position of lamps must be determined with reference to local circumstances

The Staff Engineers' Association.—The formation of this Association, it will be remembered, was proposed as a result of recent correspondence in our columns. It will have as its main object the maintenance and furtherance of the economic and social interests of mechanical, civil and electrical engineers. We learn that the intervention of the holidays has retarded the work of organisation considerably, though soon the promoters will doubt-be able to continue their endeavours in this direction. We also understand that sufficient names have been received to prove that the Association is needed. At present, however, it is considered advisable to secure the co-operation of not less than 50 well-known engineers in first-class positions, and each with a different firm. So far, about 30 companies are represented, and efforts are being made to increase this figure to the total mentioned. The greater the number of such influential supporters the better, of course, since the standing of the Association will be enhanced accordingly. Needless to say, we hope the Association will meet with success, and can assure our readers of the good faith of its promoters. The address of the Hon. Secretary is 31, Queen Victoria Street, E.C.

Twenty-Fifth Anniversary.—The twenty-fifth anniversary of the incorporation of the Gothic Works, on August 10th, 1888, by the directors of Laurence, Scott & Co., Ltd., was recently celebrated. A party of 45 of the staff and workmen, whose employment with the company averaged 23 years, was conveyed to the residence of the chairman of the company, Mr. Reginald Laurence. After inspection of the grounds, games, and an excellent tea, presentations of gold watches, travelling and other clocks were made to each of those present.

Mr. Laurence, in referring to the occasion, pointed out that there were very few electrical companies in the kingdom which held such a long record as that of Laurence, Scott & Co., Ltd., and that the position of the company was largely attributable to the excellent feeling that it had been the constant desire of the directors to promote between the staff, the workmen and themselves. From small beginnings the company had steadily progressed till, at the present time, it was employing upwards of eight hundred hands. He cordially thanked all those present for their loyal co-operation in the past, and stated that he was proud of the fine position and reputation that the company held at the present time.

Mr. J. W. Bransby, the works manager, responded gratefully on behalf of the recipients of these testimonials, and, after presentations had been made to Mr. R. Laurence, Mr. W. H. Scott and Mr. C. Wilson, the company separated with hearty cheers for Mr. and Mrs. Laurence.

Copper.—A considerable drop in English stocks took place last month, the quantity at the end of July being 18,037 tons, while that for the end of August was 16,829, 1,208 tons less. French stocks are 45 tons higher than for the end of July. Total European stocks (including Rotterdam, Hamburg, Bremen, and quantity estimated for other ports) are 1,882 less than for the end of July. Deliveries have again been heavy, amounting to 50,884 tons for the month (August). (Figures from Messrs. Merton's circular.) European arrivals from North America are well above average, Spain and Portugal to England and France low, Chile shipments again high, Australian low below the average.

For the end of July American stocks stood at 23,926 tons, a small reduction on the month. The world's supplies, excluding Holland and Germany, were 52,270 tons on July 31st, an increase of 550 tons over the figure for the end of June. Total supplies, including Holland and Germany, were 59,553, which figure is lower than that for the end of June by 2,261 tons.

The Municipal Tramways Conference.—The twelfth annual conference of the Municipal Tramways Association will be held at Sheffield on September 23rd to 26th inclusive, and judging by the contents of the official programme, the coming meeting will be no less popular than its predecessors. An informal reception will be held during the evening of the 23rd, and the real business commences the following morning at the Town Hall, where the visitors will be welcomed by the Lord Mayor.

The agenda for September 24th is as follows:—

Reception by the Lord Mayor; presidential address by Mr. A. R. Fearnley, general manager, Sheffield Corporation Tramways; paper on "Advantages and Disadvantages of Platform Fare Collection," by Ald. Flint, Leicester, followed by a discussion and midday luncheon at the invitation of the Tramways Committee.

In the afternoon a paper by Councillor Fenton, Sheffield, on "The Maintenance of Paving on Tramway Track, as affected by Section 28 of the Tramways Act, 1870," and discussion.

In the evening a visit to the Lyceum theatre and a supper at the Town Hall (both by invitation) will claim the attention of the visitors.

On Thursday morning, September 25th, a paper by Mr. J. B. Hamilton, Leeds, on "Urban Passenger Transport," will be discussed, and after luncheon, the choice of inspecting Messrs. Allen's, Hadfield's, and Osborn's Works, the Electricity Works, Car Works and Depôt, or the Sheffield University is offered to the visitors. In the evening, the annual dinner takes place at the Royal Victoria Station Hotel.

Friday, September 26th, is given up to the annual business meeting in the morning and an excursion to the Dukeries in the afternoon. Special arrangements have been made for the ladies, which include a visit to Messrs. Mappin & Webb's works and showrooms, and a 'bus excursion to Haddon Hall and Grindleford, as extra items.

Mr. Fearnley (Tramway Offices, Sheffield) is in charge of the arrangements for hotel accommodation; the Victoria Station Hotel will be the Association's head-quarters.

Electrical Research in the United States.—The success of the vehicle research work of the Massachusetts Institute of Technology, as carried out during the past two years for the Edison Electric Illuminating Co., of Boston, has been so pronounced that an extension is to be made of this department of the Institute's activities, it having been decided to establish an electrical research laboratory and bureau. The official title of the department, for which an endowment of over £22,000 has been obtained, is the Division of Electrical Engineering Research; the work of the Section will include the use of electricity in transportation, the handling of goods and telegraphic and telephonic communication.

Time Signals.—The Synchronome Co. inform us that a new edition of "Réception des Signaux Radiotélégraphiques Transmis par la Tour Eiffel" has just been published by Messrs. Gauthier-Villars, Paris (price 2.75 fr.), which they recommend to all who desire to take the wireless time signals.

Late Legal.—The X.L. Electric Co.'s Affairs.—Mr. Justice Bailhache, sitting as Vacation Judge, had before him on Wednesday, September 10th, a motion in the debenture-holders' action of in *re* the X L. Electric Co., Ltd.—Wiener *v.* the Company—for an injunction. Mr. Strode, in support of the motion, said that it was made on behalf of the plaintiff, Capt. Wiener, and it asked for an injunction to restrain the company and certain of its directors from doing any acts which would constitute an interference with the Receiver, who had already been appointed by the Court, and, further, that the company be ordered to sign any documents and do all acts necessary for a final grant of letters patent, application for which was before the Comptroller. The plaintiff regarded this as a most important application, as it was for the completion of letters patent, under which the Receiver had actually manufactured articles. Mr. Justice Astbury had, said counsel, already granted a stringent order against Mr. Aron, one of the directors, but the company had purported to hold a directors' meeting, and had written a letter dated August 25th to the Comptroller, to the effect that the company intended to abandon this final application. This was a mortgager company that had nothing further to do with the matter.

Counsel representing the company, and two of the directors, asked that the motion might stand over to answer the plaintiff's evidence, and said he was willing to undertake not to take any further steps in the meantime.

Mr. Strode said that Capt. Wiener was a director, holding half the shares in the company and all the debentures, and this application No. 19,257, of 1912, was one of the principal assets of the company. Provisional protection had been granted, but it was most essential that the protection should be completed as soon as possible. While Capt. Wiener was away, a meeting was held at which it was purported to appoint two new directors—gentlemen who had no interest in the company, and were given one share each—and then a board meeting was held, at which it was decided to abandon this application. There was evidence that Mr. Aron was present, though he took no part in the proceedings.

Counsel for the defendants said this was a directors' squabble. Mr. Aron had signed everything he was required to sign, but the company had properly passed this resolution to abandon this application for final protection, as there was no profit to be obtained from it. Mr. Aron, he understood, was appearing in person, but was not then present, and he pressed for an adjournment.

His Lordship said that he would make the order as asked, with costs.

British Vacuum Cleaner Co., Ltd., *v.* James Robertshaw and Son, Ltd.—In this patent action, in which an injunction was granted by Mr. Justice Sargant restraining an alleged infringement of the plaintiffs' patent, application was made to the Vacation Court for a stay of execution as to costs, pending an appeal. Counsel for the defendants stated that the real object of the application was to obtain from the plaintiffs an undertaking that the costs would be repaid if the appeal was successful. They had applied to the plaintiffs' solicitors for such an undertaking, but it had been refused. His Lordship asked whether there was any doubt as to the solvency of the plaintiffs. Counsel said he had no evidence on the matter. His Lordship: Then you must pay the money.

Educational Notes.—We have received from University College (University of London) the Handbook of the Faculty of Engineering, and special programme of courses arranged for engineers in practice for the forthcoming session. Particulars of the ordinary and special courses in the Faculty of Engineering are given in our advertisement pages to-day.

A course of Postgraduate Lectures on "Conductors for the Electrical Transmission of Energy" will be delivered by Prof. J. A. Fleming, F.R.S., at University College, on Wednesdays at 5 p.m., Part I ("Telegraph and Telephone Conductors") beginning on October 29th, 1913, and Part II ("Electric Light and Power Conductors") beginning on January 28th, 1914. Application for tickets of admission to be made to the Secretary, University College, London.

The Municipal School of Technology, Manchester, has sent us a copy of the Prospectus of Part-time Classes in Mechanical and Electrical Engineering for the winter session. Copies can be had on application.

Borough Polytechnic Institute.—The next session of the Department of Electrotechnics opens on September 22nd; particulars are given in our advertisement pages to-day.

Fatalities.—Mr. Frank Darling, an electrician at Sacriston Colliery, County Durham, was crushed to death at that colliery on the 3rd inst. He was going about the pit-heap, when he was crushed between two wagons and severely injured. Medical assistance was soon obtained, but he died a few hours afterwards. Mr. Darling was the son of a well-known farmer in the district, and was a popular member of the Durham City Cricket Club.

James Myles, employed in the Post Office Telephone Department, was engaged in remedying defects on the wires near Thornton, when his head came in contact with an electric cable (carried on the poles), belonging to the Fife Electric Power Co., and he was instantly killed.

London Strike.—On Saturday last the electricians employed by the Office of Works, who had been on strike, decided to return to work, after being out about a fortnight. The men returned under the conditions that obtained before they went out. They were handicapped in their dispute by want of funds, and only a few of them received strike pay.

The British Association.—The meeting opened on Wednesday evening at Birmingham with the Presidential Address delivered to a crowded and distinguished audience in the Central Hall. The building is large, but its acoustic properties are so good, and the President's voice is so clear, that he could be heard well by everyone in the audience. The ventilation was about the standard for public halls, in other words, abominable—the heat being so great that one woman was carried out in a dead faint early in the proceedings, and a few of the audience left before the address was over.

Lord Rayleigh introduced the President, and the vote of thanks was moved by the Lord Mayor of Birmingham, and seconded by Sir Joseph Larmor.

At the close of the meeting, Prof. Perry, the general treasurer, announced that Sir James Caird, of Dundee, whose magnificent gift of £10,000 to the Association last year is still fresh in the memory, had sent a further sum of £1,000 to assist the advancement of science. He also announced that the attendance up to the end of the first day was 2,506, which is, of course, a long way above the average.

Sir Oliver Lodge's address was brilliant, original, and expressed with all the wit and humour and epigram which one expects from so accomplished a speaker. The audience was held spell-bound throughout. He referred to the losses sustained by the Association by the deaths of Sir Wm. White, who was to have been President at Birmingham, Sir John Lubbock, Sir George Darwin, Prof. John Milne, and Henri Poincaré. Other features of the address are referred to in our leading columns.

Forthcoming Exhibitions.—Sheffield Fuel, Light and Power Exhibition.—The above Exhibition, which opens on October 24th, and closes on Saturday, November 15th, 1913, should prove of great interest to the Sheffield trades and to the general public. Many interesting exhibits will be on view of the newest inventions in gas, electrical and mechanical appliances for domestic and commercial use. Among the exhibitors are the following:—Corporation of Sheffield, electrical department; T. W. Ward Ltd., Babcock & Wilcox, Ltd., W. E. Burnand and Co., R. H. Hornsby & Sons, Ltd., Heenan & Froude, Ltd., Alex. Wright & Co., Ltd., Triumph Stoker Co., Marsh Bros., J. Coates and Co., G. St. John Day (Patents), Ltd., G. A. Steinthal and Boydell, Ltd., &c. One of the objects of the Exhibition will be to show visitors the latest improvements in machinery and appliances for obviating the smoke nuisance, which is of supreme importance in a great industrial centre like Sheffield. Demonstrations of cooking by electricity will be given daily. The Exhibition is being organised under expert management, and the public will be well catered for with regard to music, as the famous bands of the Royal Marines and Royal Scots Greys have been engaged. The B.E.A.M.A. has granted permission to its members to exhibit on this occasion.

Nottingham Universal Exhibition, 1914.—This Exhibition will be open from May 28th to October 3rd, and is planned on a large scale; the city is within easy range of a population of 12 millions, and no exhibition of the kind has been held there for many years. The Palace of Light will be devoted entirely to the display of methods of artificial lighting, daylight being excluded, and the "Servantless House" will be a feature of the section allotted to domestic economy and the decoration of the home. Particulars as to space, &c., can be obtained from the Executive Commissioner, Universal (1914) Exhibition, Nottingham; London offices, 6, Lloyd's Avenue, E.C.

Inquiries.—A correspondent asks for the makers of "Silesit," an insulating material. Another wants data on the subject of telephone cables, and would be pleased if any of our readers could enlighten him on the following:—Having been giving the capacity, gauge of wire, and diameter over single insulated conductor, to find the diameter over a given number of wires or pairs, allowing for compression during stranding operations.

Makers of machines for grinding, sanding, scrubbing and polishing floors, are asked for; also of the "Nodon" valve or aluminium rectifier, and of fancy electric lamps in imitation of fruit and flowers.

International Electrotechnical Commission.—We have received the fourth annual Report of the Commission, which has for frontispiece an excellent reproduction of the portrait of Faraday, painted by Miss Beatrice Bright, and presented to Dr. Budde. The second plenary meeting of the Commission was held in Berlin last week, and the third will take place in San Francisco in 1915. Electrotechnical Committees are now established in 21 countries, and others are likely to be formed in some eight others. The appointment of Special Committees to deal with various specified subjects, and to report thereon to the National Committees, has proved very successful, saving much time and expense; their work was submitted to the Commission at Berlin. The Report gives particulars of the progress made by the respective National Committees, which are now thoroughly well organised and are working on well defined and normal lines. A report of the Berlin meeting will appear next week.

Appointments Vacant.—Two telegraph inspectors for the Post and Telegraph Department of East Africa Protectorate (£160-£200); borough electrical engineer for Whitehaven (£250); instructor in electric wiring, for Huddersfield Technical College. See our advertisement pages to-day.

The Batti-Wallahs.—The Committee has arranged to visit the *Olympic* on Saturday, September 20th, at Southampton Docks.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The salary of MR. W. J. CARTER, the assistant electrical engineer to the Batley Corporation, has been increased to £145 per annum.

MR. A. HAYHURST, switchboard attendant at Dewsbury Corporation electricity works, has been presented with a handsome case of toilet requisites by the staff and employés, upon the occasion of his leaving to take up the position of shift engineer at Stockton-on-Tees electricity works.

MR. B. SANKEY has resigned the post of borough electrical engineer to the Whitehaven Corporation, which post he has held for seven years, upon receiving the appointment of assistant electrical engineer to the municipality of Port Elizabeth, South Africa, at a commencing salary of £500 per annum. He sails from Southampton, by the *Kinfauns Castle*, on October 4th next.

MR. R. J. DAVIES, of the Aberdare electricity department, has been presented with an oak overmantle by the staff on the occasion of his marriage.

The West Hartlepool T.C. has increased the salary of MR. H. F. FRIEDERICHS, borough electrical engineer, by £50 to £450 per annum.

The Leek U.D.C. on September 2nd received with regret the resignation of MR. R. M. CARR, electrical engineer, who has received another appointment. Mr. Carr has been at Leek for ten years. The Council decided to appoint a successor at £225 a year, rising by £10 per annum to £275.

MR. J. A. SMITH, engineer-in-charge at the Burton-on-Trent Corporation Electricity Works, has resigned.

The Aldershot U.D.C. has increased the salary of the electrical Engineer, MR. GARSIDE, to a maximum of £350 a year.

MR. H. WILLOUGHBY LANCE, late electrical contractor of Llandudno, and previously mains engineer of the Islington Borough Council, who left Llandudno last September for Australia, has been appointed chief engineer for the township of Geraldton, West Australia.

Tramway Officials.—MR. STANLEY DUDMAN, late manager of the tramways at Dartford for Messrs. Balfour, Beatty and Co., Ltd., has been placed in charge of the firm's new tramway system between Ripley and Nottingham. MR. D. N. R. BRUCE, late of Stroud (Glos.), has become manager at Dartford.

The traffic superintendent of the Salford Corporation tramways is to proceed to New Zealand shortly to take up an appointment there.

The salary of MR. H. PARKES, depôt superintendent, Burton-on-Trent tramways, is proposed to be increased from £140 to £145 per annum.

General.—The wedding took place last week, at Goole, of Miss Harriett Hickman and MR. JOSEPH HARROP, of Wakefield, who is head of the electrical department at Wakefield Asylum.

MR. S. BOYS, who for the past 2½ years has held the position of supplies manager to the Sheffield branch of Messrs. Siemens Bros. Dynamo Works, Ltd., is resigning this position to take up an appointment with the Edison & Swan United Electric Light Co., Ltd., where he will take charge of their London business. Mr. Boys has been associated with Messrs. Siemens in various departments for over 10 years.

MR. WILLIAM H. HAIGH has been appointed general manager at Johannesburg, of the engineering and mining supply firm of Fraser & Chalmers, Ltd.

The marriage took place on September 4th of MR. J. A. R. PITTS, head of the order department, Messrs. Crompton & Co., Chelmsford, and Miss H. M. Boswell, of Ashbourne.

On the 4th inst., at St. Mary's Church, Clitheroe, HUMPHREY FREDERICK, eldest son of Humphrey Foster, of West Bromwich, and director of Foster Bros., Ltd., Wednesbury, was married to Emma Garnett, younger daughter of Alfred Horsfall, of Clitheroe.

On September 4th MR. R. W. BLADES, of the electrical fittings department of the British Insulated and Helsby Cables, Ltd., was married to Kathleen Irene, only daughter of Mr. H. C. Tunmer, of Ipswich. The engineering staff of the works presented Mr. Blades with a handsome timepiece.

PROF. JOHN MILNE, the seismologist, who died July 31st last, left £11,927. Subject to other bequests, he gave £1,000 to the chairman of the Seismology Committee of the British Association for the study of earth physics and its attendant subjects.

Obituary.—MR. W. H. DOUGLAS.—The death has taken place at Etruria House, Pedmore, of Mr. Wm. Henry Douglas, for many years a tradesman at Stourbridge, and the inventor of one of the first meters for alternating current.

MR. CHARLES SHAW, of Blackpool, who was for several years the cashier to the Blackpool, St. Anne's and Lytham Tramways Co., died last week.

Manila Electric Railroad and Lighting Corporation.—The Municipal and General Securities Co., Ltd. (European fiscal agents), announce that a dividend of 1¾ per cent. ($1.75 per share) for the quarter ending September 30th has been declared on the common capital stock of the above Corporation, payable in New York on October 1st to stockholders of record, September 18th, 1913.

CITY NOTES.

United Electric Car Co., Ltd.

THE report of the directors for the year ending June 30th, to be submitted to the shareholders at Preston on September 17th, states that the works have been efficiently maintained as regards buildings and machinery, the cost of which has been charged against revenue. After paying debenture interest amounting to £1,783, and charging £5,951 for depreciation, the profit for the year is £10,809, to which is added £4,249 brought from last year, making a total of £15,058. The preference dividend for the six months ending December 31st, 1912, absorbs £3,000, leaving an available balance of £12,058. The directors recommend the payment of preference dividend, less income-tax, for the half-year ending June 30th, 1913, £3,000; a dividend of 5 per cent., less income-tax, on the ordinary shares for the year ending June 30th, 1913, £7,500; and to carry forward to next year £1,558. Two directors, viz., Mr. Prestwich and Mr. Kerr, retire and offer themselves for re-election.

Dumbarton Burgh and County Tramways Co., Ltd.

IN moving the adoption of the annual report, MR. GEORGE BALFOUR, chairman of directors, commented on the satisfactory nature of the year's working. The total receipts for the year amounted to £22,952, being an increase of £420 in traffic receipts and advertising, to which had to be added increased receipts from interest on deposits, temporary loans and transfer fees, making a total increase of £578, against which increased expenses had been incurred amounting to £1,015. There was every reason to believe, he said, that the current year would continue to show that the system was becoming increasingly popular. The bridge over the canal at Dalmuir, on the Glasgow Corporation lines, was now in course of construction, and would soon be completed, thus allowing the Glasgow Corporation cars to connect directly with the Dumbarton system. The company's cars ran 542,770 miles during the year and carried 3,405,391 passengers. The directors recommended a dividend on the ordinary shares, for the first time, at the rate of 1½ per cent. per annum. The dividend on the preference shares was at the rate of 6 per cent. per annum for the half-year to July 31st.

The report was unanimously approved, and the dividends recommended agreed to.

British Electric Transformer Co.—The directors have declared a dividend at the rate of 6 per cent. per annum on the ordinary shares for the past half-year.

Canadian General Electric Co.—The directors have declared a quarterly dividend at the rate of 1¾ per cent. for the three months to September 30th (at the rate of 7 per cent. per annum) on the common stock.

Direct West India Cable.—The report of the directors states that the net result of the year's working to June 30th is an available balance of £8,267, as compared with £7,764 for the previous year. The directors have dealt with the profits in the following manner:—Brought forward from 1911-12, £42,200; add profit for 1912-13, £8,267, giving an available profit of £50,480; expenses attending repairs and renewals of cable, £657; interim dividend at 3 per cent., £900; proposed final dividend at 3 per cent., £900, leaving to be carried forward, £48,022. The company's cables have worked efficiently. During the year debentures have been paid off to the amount of £7,000, leaving £15,000 outstanding.—*Financier.*

Continental.—The report of the Société Continentale d'Applications Electriques, of Basle, for the last financial year, shows a gross profit of £49,074, as compared with only £38,049 in the preceding 12 months. The dividend is being increased from 6 to 8 per cent.

The Gesellschaft fur Elektrische Kraftübertragung is the name of a new company which is being formed in St. Petersburg, with a capital of 4 million roubles, by the Société Allemande pour l'Eclairage Electrique de St. Petersburg, to take over the concessions and plant of the last-named concern.

Halifax and Bermudas Cable.—The report of the directors states that the net result of the year's working to June 30th is an available balance of £8,803, as compared with £8,533 for the previous year. The directors have dealt with the profits in the following manner:—Brought forward from 1911-12 £32,128; add profit for 1912-13, £8,803, giving an available profit of £40,931. Transferred to renewal and general reserve fund, £30,000; expenses attending repairs and renewals of cables, £3,392: proposed dividend, 6 per cent. for the year, £3,000, leaving to be carried forward, £4,539. The company's cable was interrupted near Bermuda during December last, and the necessary repairs and renewals involved an outlay of £3,392. The cable is now working efficiently.—*Financier.*

South Metropolitan Electric Light and Power Co., Ltd.—The debenture stock register and register of transfers will be closed from September 17th to 30th, 1913 (both days inclusive), for the preparation of warrants for interest for the half-year to October 1st, 1913.

STOCKS AND SHARES.

Tuesday Evening.

Markets in the Stock Exchange have scarcely recovered from their summer idleness, although people are by no means unwilling to invest money where they see what appear to be good opportunities. The lowest levels which prices have touched of late are already being left behind in quiet rises amongst many of the industrial departments. It is noticeable this week that various electric lighting shares show improvements. Business is almost confined to investment; there is little speculation going on in any of the markets. Dulness in Consols is an unfavourable factor; it is ascribed to the fear of heavy new issues being made in the near future.

So far as Home Rails are concerned, prices lean to the lower side. The Board of Trade returns published on Monday are satisfactory, their falling-off being easily explained by reference to special circumstances. There is no doubt, however, that the public are scared from the Home Railway market, at least for the time being, by the evidence which has been forthcoming at the Board of Trade inquiry into the accident on the Midland, with its lamentable loss of life. People are afraid of the railway industry for the time being; and although confidence will of course return, as it always does, prices for the moment have given way in leading cases.

We may perhaps be permitted to add another to the many expressions of regret that have followed upon the death of Mr. G. M. Lindsay, the Stock Exchange jobber, who died in the Leeds Infirmary, as the result of injuries sustained in the Midland collision. For Mr. Lindsay was ever ready to afford information, and to give the benefit of his experience in Home Railway matters, which have from time to time been discussed in this column of the Electrical Review.

Metropolitans are down ¾ on the week, but Districts show no further decline after their previous drop. Metropolitan 3½ per cent. Preference stock fell 2 points to 80. Underground Electric issues are dull; the £10 shares shed ¼ to 3⅞, the "A" shares lost 3/32, and the 6 per cent. Income bonds at 91 are a point lower. South Metropolitan Tramways 4 per cent. Debenture stocks holds its big rise of last week, and so also does the 4½ per cent. Debenture stock of the London and Suburban Company. Great Northern and City Preferred have disappeared from the Stock Exchange Official List, and, therefore, from our catalogue of prices. London United Tramways Debenture rose 1. British Electric Traction 6 per cent. Preferred gained an equal amount, the price now being 11¾ middle.

Shares in the English Supply market are mostly better, and are not easy to obtain. The rises include 5s. each in Brompton Ordinary, Metropolitans, City Preference, St. James' Ordinary, and Notting Hill Preference; Westminsters are 7s. 6d. higher, and several others are 2s. 6d. up. It is some time since we had to record improvements of this kind, and they are the more noticeable in coming at the slackest period of the year. Speculation is rife as to the meaning of the movement, and the only explanation at which the financial layman can arrive is that the market, being short of shares, is easily moved by a comparatively small amount of demand. Besides this, there is the swing of financial fashion which brings illumination shares into notice regularly every autumn.

In the Foreign group the alterations are comparatively slight. Mexican Light and Power Preference fell 2, reverting to the same level as they occupied a fortnight ago; but the First Mortgage bonds are ½ higher, while the Seconds have fallen 1 to 79. Toronto Power Debenture, which was in request a few days ago, came to market on the price being put up, and the improvement has been lost, the quotation easing off to 99. Shawinigan bonds and Royal Electric of Montreal Debenture stock are both rather higher. Mexico Trams are steady, and the company's 6 per cent. bonds at 94½ are 1½ up. Several quotations in this market have been narrowed as regards the lower and higher prices, leaving the middle prices unchanged.

The Latin-Canadian group as a whole is suffering from the scandal that has arisen in connection with the Cuban Ports Company. Although this has nothing to do with electric light or power, its shares and bonds are dealt in in the same market as those of many of the Canadian and American utility undertakings. There is no connection between the Cuban Ports and these utility concerns except the merely sentimental, but this latter is a consideration which cannot be ignored in Stock Exchange matters, and the incident has created an uneasy impression, for which really there is no justification. Cuba Telegraph shares, after their fall of 10s. last week, are another 15s. down, although the Ordinary remain steady at 8¾.

Telegraph issues as a whole are firm, and except for a decline of ¼ in Anglo-American Telegraph 5 per cent. Preferred stock there are no quotable changes. Marconis continue to cling closely to the neighbourhood of £4, speculation in them ebbing away as it was expected to do after the declaration of the dividend, the issue of the report and the holding of the meeting. The market looks dull for the time being. Of the subsidiaries, American Marconis remain about 22s. 6d., and Canadians at 12s.

The Manufacturing group retains most of the rises which it secured a week ago, but British Westinghouse Preference, after their sudden jump, reacted to the extent of 1/10, shares being on offer now at 1. British Insulateds are stronger. Henley's Debenture stock hardened to 102. Rubber shares are fairly steady, business in them falling away to retail proportions. The feature in the Stock Exchange during the past few days has been further rises in the prices of the leading copper shares upon the fresh advance in the metal itself, which seems to have a capacity for soaring far from appropriate to the quality of the article itself. On Tuesday afternoon there occurred a slight reaction, reflected at once in the prices of the principal copper shares.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and may vary according to quantities and other circumstances.

Wednesday, September 10th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a " Nitric	"	22/-	..
a " Oxalic	per lb.	3d.	½d. inc.
a " Sulphuric	per cwt.	5/6	..
a Ammoniac Sal	"	42/-	..
a Ammonia, Muriate (large crystal)	per ton	£30 10	£1 inc.
a Bleaching powder	"	£6 5	..
a Bisulphide of Carbon	"	£18	..
a Borax	"	£17 10	..
a Copper Sulphate	"	£23 15	£2 5s. inc.
a Lead, Nitrate	"	£30	£2 10s. inc.
a " White Sugar	"	£26	..
a " Peroxide	"	£32	..
c Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (88/90 %)	per ton	£22 10	..
a " Chlorate	per lb.	3½d.	..
a " Perchlorate	"	4½d.	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	"	7½d.	..
a Shellac	per cwt.	105/-	5/- inc.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	"	£8 10	..
a " Recovered	"	£5 10	..
a " Lump	"	£5	..
a Soda, Caustic (white 70/72 %)	"	£10 5	..
a " Chlorate	per lb.	3½d.	..
a " Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£96	£1 inc.
b " Wire, in ton lots (1 to 14 S.W.G.)	"	£121 6 8	..
b " Sheet, in ton lots	"	£126	..
p Babbitt's metal ingots	"	£50 to £221	..
c Brass (rolled metal 2" to 12" basis)	per lb.	8¼d.	¼d. inc.
c " Tube (brazed)	"	10⅝d.	¼d. inc.
c " " (solid drawn)	"	9¼d.	¼d. inc.
c " Wire, basis	"	8¼d.	⅜d. inc.
c Copper Tubes (brazed)	"	1/-	¼d. inc.
c " " (solid drawn)	"	11⅜d.	¼d. inc.
g " Bars (best selected)	per ton	£86	..
g " Sheet	"	£86	..
g " Rod	"	£86	..
d " (Electrolytic) Bars	"	£76 15	£3 15s. inc.
d " " Sheets	"	£94 15	£3 15s. inc.
d " " Rods	"	£82 5	£3 15s. inc.
d " " H.C. Wire	per lb.	9¾d.	⅜d. inc.
f Ebonite Rod	"	4/6	..
f " Sheet	"	4/-	..
n German Silver Wire	"	1/10	..
h Gutta-percha, fine	"	6/6 to 7/6	..
h India-rubber, Para fine	"	3/8	1d. dec.
j Iron Pig (Cleveland warrants)	per ton	54/9	..
l " Wire, galv. No. 8, P.O. qual.	"	£14	..
g Lead, English Pig	"	£20 17 6	..
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£7 5	..
e Mica (in original cases) small	per lb.	6d. to 8s.	..
e " " " medium	"	8/6 to 6/-	..
e " " " large	"	7/6 to 11/-	..
o Nickel, sheet, wire, &c.	"	3/6 to 4/6 nom	..
p Phosphor Bronze, plain castings	"	1/1 to 1/3½	..
p " " rolled bars & rods	"	1/0½ to 1/3	..
p " " rolled strip & sheet	"	1/2½ to 1/5½	..
o Platinum	per oz.	185/-	..
d Silicium Bronze Wire	per lb.	11d.	..
r Steel, Magnet, in bars	per ton	£55	..
g Tin, Block (English)	"	£196 to £198	£1 inc.
n " Wire, Nos. 1 to 16	per lb.	2/7	..
p White Anti-friction Metals	per ton	£50 to £228	..
k Zinc, Sh't (Vieille Montagne bnd.)	"	£26 10	£1 5s. inc.

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
j Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Electric Supply Co., of Victoria.—The directors have declared a dividend of 6 per cent. on the preference shares on account of arrears, allocating £2,216 for depreciation of stores, £1,000 off discount and commission on debenture stock, and carrying £7,570 forward.—*Financier.*

Hurst, Nelson & Co.—The accounts for the year ended July, 1913, will permit of the arrears of preference dividend being paid up on November 11th, 1913, together with dividend for the half-year ending on that date.—*Financial News.*

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1912.	Dividends for 1913.	Closing Quotations Sept. 9th.	Rise + or Fall —	Present Yield p.c.
	*		†			£ s. d.
Bournemouth & Poole, Ord.	10	6	5†	9½ — 10½	..	5 17 1
Do. 4½ % Pref.	10	4½	4½	8⅝ — 9⅛	..	4 14 9
Do. Second 6 % Pref.	10	6	6	9⅞ — 10⅜	..	5 15 8
Do. 4½ % Deb. Stock	Stock	4½	4½	95 — 98	..	4 11 10
Brompton & Kensington, Ord.	5	10	9†	8⅜ — 9	+ ⅛	5 11 1
Do. 7 % Cum. Pref.	5	7	7	8⅜ — 8⅝	..	4 1 2
Central Electric Supply, 4 % Guar. Deb.	100	4	4	94 — 97	..	4 2 6
Charing Cross, West End & City	5	5	5†	4⅜ — 4⅞	..	5 2 7
Do. 4½ % Cum. Pref.	5	4½	4½	4⅛ — 4⅜	..	4 17 3
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3¾ — 4	..	5 12 6
Do. Do. 4 % Deb.	100	4	4	90 — 92	..	4 7 0
Chelsea, Ord.	5	5	..	4⅜ — 5⅛	..	4 17 7
Do. 4½ % Deb.	Stock	4½	4½	94 — 97	..	4 12 9
City of London, Ord.	10	9	6†	14½ — 15½	..	5 14 3
Do. 6 % Cum. Pref.	10	6	6	12 — 13	+ ½	4 12 4
Do. 5 % Deb.	Stock	5	5	114 —118	..	4 4 9
Do. 4½ % Second Deb.	100	4½	4½	99 —101	..	4 9 1
County of London, Ord.	10	6	8†	11 — 11½	..	5 4 4
Do. 6 % Pref.	10	6	6	11⅞ — 12⅜	..	4 17 0
Do. 4½ % Deb.	Stock	4½	4½	102½ —104½	..	4 6 2
Do. 4½ % Second Deb.	Stock	4½	4½	98 —101	..	4 9 1
Edmundson's, Ord.	£8	..	..	⅜ — ⅝	..	Nil
Do. 6 % Cum. Pref.	5	6	6	4 — 4⅜	..	8 8 7
Do. 6% Non-Cum. Pref.	5	..	..	1⅝ — 2	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	80 — 83	..	5 8 5
Folkestone	5	6	6	4½ — 5	..	6 0 0
Do. 5 % Cum. Pref.	5	5	5	4½ — 5	..	5 0 0
Do. 4½ % First Deb.	100	4½	4½	89 — 91	+1	4 19 0
Hove	5	9	..	7⅞ — 8¼	..	5 9 1
Kensington & Knightsbridge, Ord	5	8	8†	7½ — 7⅞	+ ⅛	5 3 3
Do. 4 % Deb.	Stock	4	4	88 — 91	..	4 7 11
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	74 — 78	..	5 15 5
London Electric, Ord.	8	2½	..	1⅛ — 1⅜	..	4 7 9
Do. 6 % Pref.	5	6	6	4⅞ — 5¼	..	5 14 3
Do. 4 % First Mort. Deb.	Stock	4	4	89 — 92	..	4 7 0
Metropolitan	5	4	4†	3⅜ — 3⅞	+ ⅛	5 3 ..
Do. 4½ % Cum. Pref.	5	4½	4½	4⅛ — 4⅜	..	5 0 0
Do. 4½ % First Mort. Deb.	Stock	4½	4½	96 — 99	..	4 10 1
Do. 3½ % Mort. Deb.	Stock	3½	3½	78 — 81	+1	4 6 5
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	98 —101	..	4 19 0
Notting Hill, 6 % Non-Cum. Pref.	10	6	6	9½ — 10½	+ ½	5 11 7
Oxford	5	7	..	6 — 6½	..	5 11 6
St. James' and Pall Mall, Ord.	5	10	10†	8⅞ — 9¼	+ ⅛	5 8 1
Do. 7 % Pref.	5	7	7	6½ — 7	..	5 0 0
Do. 3½ % Deb.	100	3½	3½	82½ — 85½	..	4 1 10
South London, Ord.	4	5½	..	2¾ — 3¼	+ ⅛	6 15 4
Do. 5 % First Mort. Deb.	100	5	5	96 — 99	..	5 1 0
South Metropolitan, 7 % Pref.	1	7	7	1 1/32 — 1 5/32	..	6 1 3
Do. 4½ % First Deb. Stock	100	4½	4½	96 — 99	..	4 10 6
Urban, Ord.	£8	Nil	..	½ — ⅝	..	..
Do. 5 % Cum. Pref.	5	3	..	2⅜ — 2⅞	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	85 — 88	..	5 2 3
Westminster, Ord.	5	10	10†	8⅝ — 9⅛	+ ⅜	5 9 7
Do. 4½ % Cum. Pref.	5	4½	4½	4⅞ — 5¼	..	4 5 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6†	4⅝ — 5⅛	..	5 17 1
Calcutta, Ord.	5	8½	..	7 — 7½	..	5 13 4
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 17 6
Calgary Power, 1st Mort. Bds.	100	5	5	90½ — 92½	..	5 8 1
Canadian Gen. El. Com.	$100	7	7†	113 —117	..	5 19 8
Do. 7 % Pref.	$100	7	7	119 —124	..	5 12 11
Cordoba Lt., Power and T., Ord.	1	5	..	⅜ — 13/32	..	6 3 1
Do. 5 % Deb.	100	5	5	93½ — 95½	..	5 4 9
Elec. Lt. and P. of Cochabamba, 5 % Bonds	100	6	6	92 — 94	+2	6 7 8
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	87½ — 90½	..	5 10 6
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	£0½ - 92½	+ ½	5 8 2
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	3/32 — 5/32	..	Nil
Do. 6 % Pref.	1	6	..	5/16 — 7/16	..	10 13 4
Kaministiquia Power, 5 % G. Bs.	$500	5	5	102 —104	..	4 16 2
Madras, Ord.	5	Nil	..	1¼ — 1⅝	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	103 —106	..	4 14 4
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	78 — 82	..	6 1 11
Mexican Lt. & Power, Common	$100	4	4	66 — 70	..	5 14 4
Do. 7 % Cum. Pref.	$100	7	7	95 —100	−2	7 0 0
Do. 5 % 1st Mort. Gold Bds.		5	5	90½ — 92½	+ ½	5 8 1
Do. 5 % 2nd Mort. Bonds	100	5	5	78 — 80	−1	6 5 0
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	74 — 77	..	6 9 10
Montreal, Lt., H. and Power	$100	9	10†	215 —225	..	4 0 0
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5a	5a	15 — 25	..	..
River Plate, Ord.	Stock	10	..	207 —217	..	4 8 0
Do. 6 % Non-Cum. Pref.	Do.	6	6	102 —107	..	5 9 1
Do. 5 % Deb. Stock	Do.	5	5	97½ — 99½	..	4 19 6
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	101 —103	+1	4 7 5
Shawinigan Water, Capital	$100	5½	6†	140 —144	..	3 16 5
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	105½ —107½	+ ½	4 13 0
Do. 4½ % Per. Deb.	Stock	4½	4½	99½ - 102½	..	4 7 10
Toronto Power, 4½ % Deb.	Do.	4½	4½	98 —100	− ½	4 10 0
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	90½ — 92½	..	5 8 1
Victoria Falls Power, Pref.	1	6	..	11/32 — 13/32	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	103 —105 xd	..	5 14 3

TELEGRAPH AND TELEPHONE COMPANIES.

Anglo-American Telegraph	10	4½	..	6 7/32 — 7/8	..	6 2 0
Do. 5 % Deb. Red.	Stock	5	5	94 — 96	..	5 3 2
American Telep. & Teleg., Cap.	$100	8	8	133 —135	..	5 18 6
Do. Collat. Trust	$1000	4	4	90 — 92	..	4 7 0
Anglo-American Telegraph	Stock	3	3	62 — 65	..	4 12 4
Do. 6 % Pref.	Do.	6	6	107 —108	− ½	5 11 2
Do. Def.	Do.	30/-	..	29½ — 29⅞	..	6 6 4
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	102 —104	..	4 16 2
Chili Telephone	5	8	..	7 15/16 — 7 31/32	..	5 5 10
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	82 — 84	..	4 15 3
Cuba Telegraph	10	6	6†	8½ — 9½	..	6 9 9
Do. 10 % Pref.	10	10	10	14½ — 15½	− ⅜	6 9 0
Direct Spanish Telegraph, Ord.	5	4	..	8¼ — 8⅝	..	5 6 8
Do. 10 % Cum. Pref.	5	10	..	6⅞ — 7⅛	..	6 12 0
Direct United States Cable	10	4	4†	6⅞ — 7⅛	..	5 12 3
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	98 —100	..	4 10 0
Eastern Telegraph, Ord. Stock	Stock	7	7	127 —130	..	5 7 8
Do. 3½ % Pref. Stock	Do.	3½	3½	75 — 77	..	4 10 11
Do. 4 % Mort. Deb.	Do.	4	4	95 — 97	..	4 2 6
Eastern Extension	10	7	7	12½ — 13	..	5 7 8
Do. 4 % Deb.	Stock	4	4	92 — 94	..	4 5 1
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	99 —101	..	3 19 3
Globe Telegraph and Trust	10	6	6†	11 — 11½	..	5 4 4
Do. 6 % Pref.	10	6	6	12½ — 12⅝	..	4 15 1
Great Northern Telegraph	10	20	5†	30 — 32	..	6 13 0
Indo-European Telegraph	25	13	..	55½ — 57½	..	5 13 1
Mackay Companies Common	$100	5	5	85 — 88	..	5 13 8
Do. 4 % Cum. Pref.	$100	4	4	66 — 70	..	5 14 4
Marconi's Wireless Telegraph	1	20	..	3⅞ — 4	− ⅛	5 0 0
Do. 7 % Cum. Partic. Pref.	1	17	..	3 15/16 — 4 1/16 xd	..	4 18 11
Monte Video Telephone, Ord.	1	6	6	31/32 — 1 3/32	−1/32	5 9 8
Do. 5 % Pref.	1	5	5	7/8 — 31/32	..	5 14 3
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	100 —101	+ ½	4 9 1
Oriental Telep. and Elec.	1	10	..	1 31/32 — 1 33/32	..	5 8 6
Do. 6 % Cum. Pref.	1	6	6	1 1/16 — 1 1/8	..	4 16 0
Do. 4 % Red. Deb.	Stock	4	4	86 — 88	− ½	4 10 11
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	96 — 98	..	4 1 8
Reuter's	10	10	10†	9¾ — 10½	..	9 17 6
Submarine Cables Trust	Cert.	6	6	124 —127	..	4 14 6
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	95 — 97	..	4 12 9
United River Plate Telephone	5	8	6†	6½ — 7	..	5 14 4
Do. 5 % Cum. Pref.	5	5	5	5 — 5½	..	4 11 0
West Coast of America	2½	2½	..	1 3/32 — 1 1/16	..	4 8 4
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	93 — 96	..	4 1 8
West India and Panama Teleg.	10	1½	..	2⅝ — 2⅞	..	4 6 11
Do. 6 % Cum. 1st Pref.	10	6	6	9⅜ — 10⅜	..	5 18 5
Do. 6 % Cum. 2nd Pref.	10	6	6	9⅜ — 9¾	..	6 1 6
Do. 5 % Debs.	100	5	5	99 —101	..	4 19 0
Western Telegraph, Ltd.	10	7†	7	12⅜ — 12¾	..	5 5 8
Do. 4 % Deb.	Stock	4	4	90½ — 92½	..	4 6 6
Western Union 4½ % Fdg. Bonds	$1000	4½	4½	92 — 95	..	4 14 9

Unless otherwise stated, all shares are fully paid. a Paid in deferred interest warrants. † Interim Dividend. 8s. in Funded Dividend Certs.

Continued on next Page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1912.	Dividends for 1913.	Closing Quotations Sept. 9th.	Rise + or Fall —	Present Yield p.c. £ s. d.
	*					
Bath Trams, Pref. Ord.	1	Nil	..	3/16 — 5/16	..	Nil
Do. 5 % Pref.	1	5	5	3 3/16 — 3 5/16	..	6 8 0
Do. 4½ % Deb.	100	4½	4½	72 — 77	..	5 17 0
Brit. Elec. Trac., 6 % Pref.	100	..	..	11 — 13½	+1	..
Do. Do. Deferred	100	..	..	4½ — 6	..	..
Do. Do. 6 % Cum. Pr'f.	100	6	6	86 — 89	..	6 14 10
Do. 7 % Non-Cum. Pr'f.	100	3	..	47 — 50	..	6 0 0
Do. 5 % Perp. Deb.	100	5	5	91 — 94	..	5 6 5
Do. 4½ % 2nd Deb.	100	4½	4½	75 — 78	..	5 15 5
Central London Railway, Ord.	100	3	3	73 — 75	..	4 0 0
Do. Gtd. Assented	100	..	4	80 — 82 xd	..	4 17 7
Do. Pref.	100	4	4	77 — 79	..	5 1 3
Do. Gtd. Assented	100	..	4	81 — 83 xd	..	4 16 8
Do. Def.	100	2	..	75 — 77	..	2 12 0
Do. Gtd. Assented	100	..	4	79 — 81 xd	..	4 18 9
Do. 4 % Deb.	100	4	4	97 — 99	..	4 0 10
City & S. London, 5 % Pref., 1891	100	5	5	98 —100	..	5 0 0
Do. Do. 1896	100	5	5	98 —100	..	5 0 0
Do. Do. 1901	100	5	5	97 — 99	..	5 1 0
Do. Do. 1908	100	5	5	97 — 99	..	5 1 9
Do. 4 % Deb.	100	4	..	93 — 95	..	4 4 8
Hastings Trams, 6 % Pref.	1	6	6†	17/32 — 19/32	..	7 13 7
Do. 4½ % Deb.	100	4½	4½	68 — 73	..	6 3 3
Isle of Thanet Trams, 5 % Pref.	5	2½	..	2½ — 2⅝	..	4 15 3
Do. 4 % Deb.	100	4	4	73 — 78	..	5 2 7
Lancashire United, 5 % Deb.	100	5	5	76 — 78	..	6 8 2
London and Suburban, Ord.	1	..	..	1/32 — 3/32	..	..
Do. Do. 5 % Cum. Pref.	1	..	5†	5/16 — 7/16	..	..
Do. Do. 4½ % 1st. Deb.	100	4½	4½	74 — 79	..	5 13 11

NAME.	Stock or Share.	Dividends for 1912.	Dividends for 1913.	Closing Quotations Sept. 9th.	Rise + or Fall —	Present Yield p.c. £ s. d.
	*					
London Elec. Railw'ys, 4 % Deb.	100	4	4	91 — 93	..	4 6 0
London United Trams, 4 % Deb.	100	4	4	61 — 65	+1	6 3 1
Metropolitan Railway Consol.	100	1⅝	1½†	47 — 47½	— ¾	3 8 5
Do. Surplus Lands	100	2¾	2¾†	59 — 61	..	4 10 2
Do. 5½ % Deb.	100	5½	5½	83 — 85	..	4 2 4
Do. 5½ % Pref.	100	5½	5½	79 — 81	..	4 6 5
Do. 5½ % Con. Pref.	100	5½	5½	77 — 79	..	4 8 7
Metropolitan District Ord.	100	Nil	..	34½ — 35	..	Nil
Do. 6 % Deb.	100	6	6	136 —139	..	4 6 4
Do. 4 % Deb.	100	4	4	92 — 94	..	4 5 1
Do. 4 % Prior Lien	100	4	4	95 — 97	..	4 2 6
Do. 4½ % First Pref.	100	4½	4½	82 — 84	..	5 7 2
Do. 5½ % Gtd.	100	5½	5½	74 — 76	..	4 12 1
Metro. Elec. Trams, 4½ % Deb.	100	4½	4½	84 — 88	..	5 2 3
Do. 5 % Deb.	100	5	5	90 — 93	..	5 7 6
Potteries, Ord.	1	3½	..	9/32 — 11/32	..	..
Do. 5 % Pref.	1	5	5	13/16 — 15/16	..	7 5 6
Do. 4½ % Deb.	100	4½	4½	82 — 85	..	5 6 5
South Metro. Trams, 6 % Pref.	1	6	6†	3/4 — 7/8	..	8 0 0
Do. 4 % Deb.	100	4	4	68 — 72	..	5 11 1
Underground Elec. Railways	10	..	..	3¾ — 4	— ⅛	Nil
Do. "A"	1/-	..	..	1/32 — 3/32	— 3/32	Nil
Do. 6% First Cum. Inc. Deb.	100	6	6	109 —111	..	5 8 1
Do. 4½ % Bonds	100	4½	4½	99 —101	..	4 9 1
Do. 6 % Income	100	6	6	20½ — 21½	—1	6 11 2
Yorkshire (West Riding), Ord.	5	Nil	..	1/4 — 3/8	..	Nil
Do. 6 % Pref.	5	8	1½†	3⅜ — 3¾	..	..
Do. 4½ % Deb.	100	4½	4½	81 — 85	..	5 6 0

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5⅛	5⅛	4 11/16 — 4 15/16	..	5 11 4
Do. 2nd Pref.	5	5⅛	5⅛	4⅜ — 4⅝	..	5 18 11
Do. 4 % Deb.	100	4	4	12 — 94	+ ½	4 5 1
Do. 4½ % Deb.	100	4½	4½	96 — 98	+ ½	4 11 10
Do. 5 % Deb.	100	5	5	98 —100	..	5 0 0
Auckland Trams, 5 % Deb.	100	5	5	100 —102	..	4 18 0
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅞ — 11⅛	..	5 4 4
Do. 4½ % Deb.	100	4½	4½	94 — 96	..	4 13 9
Do. 5 % 2nd Deb.	100	5	5	96 — 99	..	5 1 0
Brazilian Traction Light and Power	$100	6	6†	95½ — 96½	..	6 4 4
Brisbane Trams Invt., Ord.	5	8	8†	7⅛ — 7⅜	+ ⅛	5 5 0
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 8 11
Do. 4½ % Deb.	100	4½	4½	99 —102	+1	4 8 3
B. Columbia Elec. Rly., Def.	100	8	8†	126 —129	..	6 4 0
Do. Pref. Ord.	100	6	6	102 —115	..	5 4 4
Do. 5 % Pref.	100	5	5	102⅛ — 105⅛	+ ⅛	4 14 9
Do. 4½ % 1st Mort. Deb.	40	4½	4½	100 —103	..	4 7 5
Do. 4½ % Vancouver Deb.	100	4½	4½	100 —102	..	4 8 8
Do. 4½ % Con. Deb.	100	4½	4½	95 — 97	..	4 7 8
Calcutta Trams, Ord.	5	7½	..	5⅞ — 6⅛	..	5 12 0
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 17 7
Do. 4½ % Deb.	100	4½	4½	96 — 99	..	4 11 0
Cape Electric Trams	1	5	..	1/4 — 1/2	..	6 8 1
City Buenos Aires Trams (1904)	5	5†	5	5 3/16 — 5 5/16	..	4 9 11
Do. 4 % Deb.	100	4	4	92 — 97	..	4 2 6
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	90½ — 94½	..	5 5 10
Havana Elec. Rly., 5 % Bonds	$1000	5	5	94½ — 98½	..	5 1 6
Kalgoorlie Elec. Trams	1	Nil	..	1/16 — 3/16	..	Nil
Do. 5 % A Deb.	100	5	5	85 — 90	..	5 11 1
Do. 5 % B Deb.	100	3	..	25 — 35	..	..

La Plata Elec. Trms, Ord.	1	..	..	1/16 — 1/32	..	..
Do. Pref.	1	4½d.	6	3/32 — 5/32	..	5 16 6
Lisbon Elec. Trams, Ord.	1	6	6†	1 3/16 — 1 3/32	..	4 9 8
Do. 6 % Pref.	1	6	6	1 — 1½	..	4 16 0
Do. 5 % Deb.	100	5	5	91 — 96	..	5 4 2
Madras Elec. Tr. 6% Cum. Pref.	5	6	6	4½ — 5¼	..	5 17 1
,, Elec. Tr. (1904), Deb.	100	5	5	101 —103	..	4 17 1
Manaos Trams & Lt., 1st Deb.	100	5	5	87 — 89	..	6 12 4
Manila Elec. R. and Lig., Bonds	$1000	5	5	97 — 99	..	5 1 0
Mexico Trams Com.	$100	7†	7	98½ — 100½	..	6 19 4
Do. Gen. Con. 5 % Bonds	..	5	5	89½ — 91½ xd	+ ½	5 9 3
Do. 6 % Bonds	100	6	6	93¼ — 95½	+1½	6 5 8
Para Elec. Rlys. & Lt., Ord.	5	10	10†	6 — 6½	..	7 13 10
Do. 6 % Pref.	5	5	6	4⅞ — 5½ xd	..	5 17 1
Do. 5 % 1st Deb.	100	5	5	98½ — 100½	..	4 19 6
Perth (W.A.) Elec. Tr., Ord.	1	5½	..	1¼ — 1⅜	..	4 0 0
Rangoon El. Tr. & Sup., Pref.	5	6	6	5 — 5½	..	5 9 1
Do. 4½ % 1st Deb.	100	4½	4½	95 — 97	..	4 12 9
Rio de Janeiro Trams, 1st Mort. 5 % Bonds	..	5	5	101½ — 102½	..	4 17 6
Do. 5 % Mort. Bonds	100	5	5	95½ — 96½	..	5 3 8
Sao Paulo Tram, Lt. and P. 5 % 1st Deb.	$500	5	5	102 — 104	..	4 16 2
Singapore Trams, 5 % Deb.	100	5	5	85 — 89	..	5 12 4
Southern El. Tr. B.A., 5 % Deb.	100	5	5	93 — 95	..	5 5 3
Un. Elec. Trams Monte Video	5	7	7	4⅜ — 5	..	7 0 0
Do. 6 % Pref.	5	6	6	4 13/16 — 5 1/16	..	5 18 7
Do. 5 % 1st Deb.	100	5	5	97 —100	..	5 0 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	101 —103	..	4 7 5

MANUFACTURING COMPANIES.

Aron, Ord.	1	7	..	3/8 — 13/32	..	7 7 8
Do. 6 % Pref.	1	6	6	13/32 — 17/32	..	7 2 6
Babcock & Wilcox	1	16	..	8 1/32 — 8 3/32	..	5 0 5
Do. Pref.	1	6	6	1 15/16 — 2 1/16	..	4 3 6
British Aluminium, Ord.	1	..	..	1 29/32 — 1 31/32	..	..
Do. 6 % Cum. Pref.	1	6	6	1 29/32 — 1 31/32	..	6 8 0
Do. 5 % Prior Lien Debs.	100	5	5	93 — 96	..	5 5 3
Do. Deb. Stk.	100	5	5	83 — 86	..	5 16 8
B.I. & Helsby Cables	5	10	..	8 — 8½	+ ¼	5 17 6
Do. Pref.	5	6	6	5⅞ — 6⅛	..	4 16 0
Do. Deb.	100	4½	4½	99 —102	..	4 8 3
British Thomson-Houston, Deb.	100	4½	4½	92½ — 95½	..	4 14 0
British Westinghouse, Pref.	3	Nil	..	1/8 — 1 1/16	—1/16	Nil
Do. Deb.	100	4	4	66 — 69	..	5 15 11
Do. 6 % Prior Lien	100	6	6	101 —104	..	5 15 5
Browett, Lindley, Ord.	1	..	..	2/- —3/-	..	Nil
Do. Pref.	1	..	..	4/6 —5/-	..	Nil
Brush, 7 % Pref.	2	Nil	..	0 — ½	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	70½ — 75½	..	6 12 5
Do. 4½ % Deb	100	4½	4½	85¾ — 40½ xd	..	11 2 2
Do. 4½ % Second Deb.	100	4½	4½	93 — 97	..	16 13 4
Callender's Cable	5	15	..	10⅞ — 11⅛	..	6 10 5
Do. Pref.	5	5	5	4 13/16 — 5 1/16	..	4 18 9
Do. Deb.	100	4½	4½	96 — 99	..	4 10 6
Cartner-Kellner	1	20	..	8 1/16 — 8 3/16	..	5 4 11
Do. Deb.	100	4½	4½	102 —105	..	4 5 9

Crompton & Co., Deb.	100	5	..	54½ — 59½	..	8 8 0
Dick, Kerr	1	Nil	..	3/4 — 7/8	..	..
Do. Pref.	1	6	6	1 1/16 — 1 3/16	..	7 13 10
Edison & Swan, A, £8 paid	5	Nil	..	0 — ⅛	..	Nil
Do. fully paid	5	Nil	..	1¼ — 1⅜	..	Nil
Do. 4 % Deb.	100	4	4	58 — 62	..	6 9 1
Do. 5 % Second Deb.	100	5	5	65 — 70	..	7 2 10
Electric Construction	1	5	..	1 — 1¼	..	8 0 0
Do. Pref.	1	7	7	1 13/32 — 2 1/16	..	6 15 9
Greenwood & Batley, Pref.	10	7	7	7¾ — 8	..	8 6 8
Do. Deb.	100	5	..	92 — 94	..	5 4 2
General Electric, 6% Pref.	10	6	6	9½ — 10¾	..	5 14 3
Do. Deb.	100	4	4	89 — 94	..	4 5 1
Henley's, Ord.	5	15	10†	12½ — 13	..	5 15 5
Do. Pref.	5	4½	4½	4 13/16 — 5 1/16	..	4 8 11
Do. Deb.	100	4½	4½	101 —103	+ 1	4 7 5
India-Rubber, G. & T.	10	7½	..	12⅞ — 13⅞	..	5 9 1
Do. Pref.	10	5	5	9⅝ — 10⅝	..	4 18 9
Telegraph Construction	12	20	5†	37 — 39	..	6 3 1
Do. Deb.	100	4	4	95 — 97	..	4 2 6
Willans & Robinson	1	Nil	..	1/4 — 3/8	..	Nil
Do. Pref.	5	Nil	..	1/2 — 1	..	Nil
Do. Deb.	100	4	4	55 — 57	..	7 0 4

* Unless otherwise stated all shares are fully paid. † Interim dividend.

Bank rate of Discount 4½ per cent., April 17th, 1913.

TRADE STATISTICS OF MEXICO.

THE following figures, showing the imports of electrical and similar materials into Mexico during the year ended June 30th, 1912, are taken from the recently-issued official trade statistics; the figures for the previous year are given for purposes of comparison, with notes of increases or decreases :—

Peso = 2s. 0½d.

	1910-11. Pesos.	1911-12. Pesos.	*Inc. or dec.* Pesos.
Copper, brass or bronze wire, covered with other materials.—			
From Germany	83,000	64,000	— 19,000
„ Austria	2,000	—	— 2,000
„ United States ...	461,000	458,000	— 3,000
„ France	1,000	1,000	—
„ Great Britain ...	4,000	1,000	— 3,000
„ Other countries ...	9,000	1,000	— 8,000
Total ...	560,000	525,000	— 35,000
Copper, brass or bronze wire, bare.—			
From Germany	40,000	38,000	— 2,000
„ United States ...	364,000	180,000	— 184,000
„ Great Britain ...	9,000	8,000	— 1,000
„ Other countries ...	7,000	17,000	+ 10,000
Total ...	420,000	243,000	— 177,000
Cables of copper, brass, &c., not armoured.—			
From Germany	23,000	47,000	+ 24,000
„ Austria	8,000	1,000	— 7,000
„ United States ...	231,000	500,000	+ 269,000
„ Great Britain ...	20,000	3,000	— 17,000
„ Other countries ...	30,000	6,000	— 24,000
Total ...	312,000	557,000	+ 245,000
Cables of copper, &c., armoured.—			
From Germany	50,000	162,000	+ 112,000
„ United States ...	129,000	121,000	— 8,000
„ Great Britain ...	121,000	71,000	— 50,000
„ Other countries ...	2,000	12,000	+ 10,000
Total ...	302,000	366,000	+ 64,000
Insulators of glass or porcelain.—			
From Germany	17,000	39,000	+ 22,000
„ Austria	3,000	5,000	+ 2,000
„ United States ...	84,000	99,000	+ 15,000
„ Other countries ...	1,000	2,000	+ 1,000
Total ...	105,000	145,000	+ 40,000
Commutators, interrupters, contacts, safety cut-outs, &c.—			
From Germany	92,000	307,000	+ 215,000
„ Austria	1.000	3,000	+ 2,000
„ United States ...	277,000	362,000	+ 85,000
„ France	11,000	1,000	— 10,000
„ Great Britain ...	4,000	6,000	+ 2,000
„ Other countries ...	5,000	2,000	— 3,000
Total ...	390,000	681,000	+ 291,000
Incandescent electric lamps.—			
From Germany	233,000	183,000	— 50,000
„ Austria	26,000	11,000	— 15,000
„ United States ...	398,000	442,000	+ 44,000
„ France	11,000	7,000	— 4,000
„ Great Britain ...	2,000	1,000	— 1,000
„ Switzerland ...	1,000	—	— 1,000
„ Other countries ...	11,000	3,000	— 8,000
Total ...	682,000	647,000	— 35,000
Machines for industries, mining, &c.—			
From Germany	2,955,000	2,526,000	— 429,000
„ Austria	6,000	3,000	— 3,000
„ Belgium	139,000	146,000	+ 7,000
„ Canada	5,000	—	— 5,000
„ Spain	43,000	21,000	— 22,000
„ United States ...	16,661,000	15,001,000	—1,660,000
„ France	394,000	354,000	— 40,000
„ Great Britain ...	3,158,000	2,725,000	— 433,000
„ Italy	46,000	107,000	+ 61,000
„ Sweden	219,000	109,000	— 110,000
„ Switzerland ...	125,000	242,000	+ 117,000
„ Other countries ...	18,000	15,000	— 3,000
Total ...	23,769,000	21,249,000	—2,520,000
Arc lamps.—			
From Germany	16,000	52,000	+ 36,000
„ United States ...	35,000	34,000	— 1,000
„ Other countries ...	1,000	1,000	—
Total ...	52,000	87,000	+ 35,000
Scientific instruments and apparatus.—			
From Germany	114,000	94,000	— 20,000
„ United States ...	218,000	151,000	— 67,000
„ France	74,000	100,000	+ 26,000
„ Great Britain ...	13,000	11,000	— 2,000
„ Italy	29,000	7,000	— 22,000
„ Other countries ...	8,000	7,000	— 1,000
Total ...	456,000	370,000	— 86,000

HIGH-FREQUENCY ALTERNATORS AND THEIR USE IN RADIO-TELEGRAPHY AND TELEPHONY.

Use of Sustained Oscillations in Wireless Telegraphy.—Hitherto the oscillations employed in wireless telegraphy have generally been obtained by the sudden discharge, by means of a spark, of an oscillating system comprising a condenser and self-induction. The discharge current then flowing is heavily damped, and, as a function of time, is represented by an equation of the form $I = A e^{-at} \sin \omega t$. By induction, the generating system will give rise to oscillating currents in a second oscillating system even if the period ($2\pi\sqrt{LC}$) of the latter is not identical with that of the former. By analogy with the phenomena of sound, one would expect the "resonator" only to respond to stimuli possessing its own natural frequency. That this is not the case is due to the fact that heavily damped oscillations produce, in a circuit having a smaller coefficient of damping, the same effect as a blow on a pendulum; the equilibrium of the resonator is disturbed, and oscillations then follow with the natural frequency of the circuit concerned. Bjerknes' classical formulæ, expressing the behaviour of various resonators under the influence of a given exciter, show that under the ordinary conditions of practice, the energy received is greater the more nearly the natural frequency of the receiving circuit coincides with that of the exciter and the smaller the damping in the latter. On the other hand, for a given difference between the natural frequencies of the two circuits, the energy received is less the less the damping in the exciting circuit. It is, therefore, doubly desirable to reduce the damping of the exciting system, since the efficiency of excitation of the transmitting aerial is thereby increased and syntony is improved—*i.e.*, the receiving system becomes less affected by stimuli of frequency other than its natural frequency. The advantages of syntonic working are too well known to need recapitulation.

It is rather fortunate that very lightly damped waves could not be generated in the early days of wireless telegraphy, for, using them, the crude regulating devices then employed would have given poor results. Moreover, the first used detector, the coherer, depended for its action not on the total energy received but on the amplitude of the first oscillation in each train, hence the degree of damping was of little importance. Improvements in receiving apparatus and the substitution for coherers of electrolytic, and particularly of crystal detectors, depending for their action upon the total energy received, have, however, rendered more and more necessary the generation of lightly damped and even sustained oscillations, such as are provided by alternators; sustained oscillations are especially desirable in radio-telephony.

The telephone almost exclusively is used at the present day for the reception of wireless signals. The electrical oscillations set the receiver membrane in oscillation, but with a frequency far above the limit of audibility. Where damped waves are used, subsidiary membrane vibrations are set up corresponding to the discontinuity of the numerous trains of waves which go to make up each signal, but sustained radiations of constant amplitude produce no effect in the telephone audible to the ear. If, however, the amplitude of the oscillations be varied periodically with suitable frequency, a note of corresponding frequency is heard in the telephone, and if, in the transmitting circuit, the amplitude of the sustained high-frequency oscillations be varied by aid of a microphone, corresponding sounds are reproduced in the receiving telephone, *i.e.*, wireless telephony is achieved.

The necessary high-frequency fundamental oscillations were obtained during the first wireless telephony experiments by the well-known arc system, but this apparatus operates with some irregularity, which can be overcome by the use of high-frequency alternators.

High-Frequency Alternators.—The first endeavours to realise alternators providing current of suitable frequency were directed towards a sufficient increase in the number of poles and R.P.M. of generators of the same type as had hitherto been employed to supply 50 or 100 cycles per second in central-station networks. It is easy to show that even when driving the rotor at the absolute maximum peripheral speed permitted by the centrifugal stresses thereby set up, the pole pitch required for the generation of

frequencies of the order desired becomes impracticably small, at least so far as concerns the generation of any considerable power. The pole thickness can hardly be reduced below 2 or 3 mm., and before this limit is reached, inefficiency is incurred by the serious magnetic leakage between poles, by heating and windage losses and hysteresis and by eddy iron losses (increasing respectively with the frequency and the square of the frequency). Abnormal rotor speeds necessarily involve high windage losses, and the use of iron in a high-frequency alternator inevitably involves heavy hysteresis and eddy-current losses. For instance, to an alternating field of 150 kcy., steel plates, 0·05 cm. thick, offer an apparent permeability of 15 and, in a field of 2·2 gauss, the losses are 30 watts per kg. Silicon-steel plates, 0·022 cm. thick, offer an apparent permeability of 63 and the losses rise to 150 watts per kg. These results correspond to a true permeability between 150 and 200, indicating (says R. Jouast in a recent article from which these notes are abstracted), a change in the magnetic properties of iron at high frequency. These losses may be diminished considerably by subdividing the iron, but a limit is soon reached in this direction. It is very difficult to utilise satisfactorily iron wire; manufacture becomes a delicate matter and the cost of the machines high. On the other hand, it is difficult to obtain high output from ironless alternators. Finally, the small space available for the windings compels the use of fine wire, and hence involves high copper losses in the machine.

Up to 1901, 16 types of high-frequency alternator had been built (see also Fleming, "Principles of Electric Wave Telegraphy and Telephony," pages 5-13), but none had proved capable of supplying sufficient power at sufficiently high frequency. Tesla built two machines in 1889 and 1891, but no particulars of their performance appear to have been published. Pyke and Harris built a 200-watt, 8·7-kcy. machine for Sir David Salomons, and Parsons built a 400-watt, 14-kcy. alternator for Ewing, but these machines were of too small capacity and far too low frequency to be of any use for wireless work. Duddell obtained a suitable frequency (100 kcy.) in his alternator, built on the principle of Wien's siren, but, though needing a powerful motor to drive it, the output of this alternator was only 0·2 watt. In 1904, Lamme (Westinghouse, Pittsburg) built a rotating-iron alternator yielding 2 KVA. (150 volts, 13·3 amperes), at 10 kcy., but in this machine (which was designed for Leblanc's multiple telephony experiments) the air losses amounted to 3·3 KW., and the peripheral speed of the rotor when running at 3,000 R.P.M. was 1,075 ft. per second.

Between 1905 and 1907, Fessenden constructed and used two alternators of the Ferranti type, in which the use of iron was avoided in all parts where the flux was variable. The output of these machines was 1 KW. at 81·7 kcy., and 2·5 KW. at 75 kcy. It does not seem, however, that these machines achieved all that had been expected from them, for Fessenden continued his researches in collaboration with Alexanderson, whose 1910 alternator was the first industrially successful machine to yield 100 kcy. supply.

Referring to fig. 1, which shows the essential features of this machine, the rotor is of nickel chrome steel shaped approximately to the form of a solid of uniform resistance; its diameter being ca. 12 in., the peripheral speed at 20,000 R.P.M. approaches 1,000 ft. per second. The rotor disk has closed slots in its periphery and runs in the air gap of an electro-magnet formed by the yoke B D E and the field windings A. The passage of the rotor slots provokes flux variations in the portion E of the yoke and this part—the only one in which the flux is variable—is laminated (0·1 mm. plates) and pierced by holes, from each of which to the next the winding is wound in the form of a zig-zag. The rotor has 300 slots and the stator 600 tunnels. To reduce windage losses, the rotor slots are filled with non-magnetic material—soldered and mechanically locked in place. The portions B of the yoke being screwed in D, the air gap length can be adjusted. Its normal length is about 0·4 mm. As in the Laval turbine, a certain degree of flexibility is provided in the shaft in order that slight errors in balancing may be self-compensating; the shaft diameter at the extremity is 0·6 in. and the distance between bearings 28 in.

Two critical speeds are passed when starting up: at 1,700 R.P.M., the shaft vibrates between its bearings; and at 9,000 R.P.M., the rotor oscillates from side to side of its plane of symmetry, the shaft inflecting in S form. Auxiliary bearings near the rotor (which are idle when the latter runs steadily at full speed) limit the amplitude of these vibrations. Any magnetic irregularity tending to produce lateral displacement of the rotor results in heating of one auxiliary bearing, and the resulting thermal expansion of the shaft in the neighbourhood corrects the rotor position automatically.

The short-circuit current of the machine is 20 amperes, and the open-circuit pressure 100 volts. A current of 30 amperes produces 45° temperature rise. When excited so as to produce 110 volts on open circuit, the terminal pressure falls to 60 volts when the output is 15 amperes. Operation is improved when a condenser is connected across the terminals, as is the case when the machine is used for wireless purposes. Although the copper is only 0·41 mm. in diameter, its temperature rise is only 25° C. when traversed by 15 amperes, owing to the intimate thermal contact with the surrounding iron. The windage losses amount to 5 KW. and increase as the 2·7th power of the speed. The iron losses are from 500 to 600 watts, and the overall efficiency is obviously very low.

Subsequently, Alexanderson built a 200-kcy. machine, in the construction of which fresh difficulties were encountered. It was impossible to double the speed of a machine of the above type (owing to mechanical considerations and the excessive windage losses incurred), and the dimensions of the machine would not permit the number of teeth to be doubled. In the new machine 800 armature tunnels were provided, and the winding was so modified that at the same rotor speed as before, the frequency was doubled

The enormous speed at which the rotor has to be driven in all the types of alternators so far considered inevitably introduces mechanical complications and excessive windage losses, hence various attempts have been made to obtain the desired results by combining mechanical rotation with the properties of rotating fields.

The principle of such machines was indicated in 1894 by Jarvis-Patten and Arnold. Suppose two two-phase induction-type alternators to be mounted on the same shaft, the first to be excited by D.C., and the sections of its rotor to be connected in series with those of the second alternator. The F frequency current generated by the first alternator produces in the rotor of the second machine

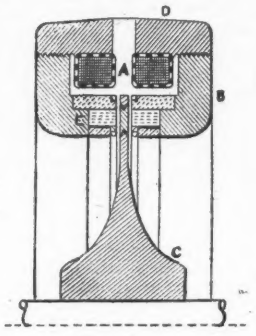


FIG. 1.

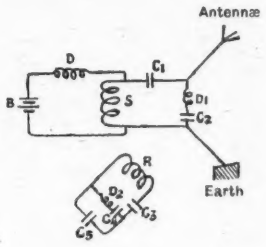


FIG. 2.

a field rotating at the speed corresponding to F with regard to this rotor (owing to the crossing of the intermediate connections). This field clearly induces currents of frequency 2 F in the stator of the second alternator, and, by placing n alternators on the same shaft and adopting the above system of connection throughout, current of (n F) frequency is ultimately obtained; but the efficiency of each alternator affects the resultant overall efficiency, and in order that the latter may be high, the number of machines must be few, and hence the frequency of the first high. Under these circumstances the two-phase winding (two slots per pole) stands at a disadvantage as compared with a one-phase winding, and single-phase alternators can be used quite as well in the above system.

The alternating field produced by an A.C. system traversing the winding of a one-phase machine can be resolved into two fields rotating in opposite directions with regard to the winding concerned (Leblanc's theory), hence, in any one of a number of one-phase alternators connected as above, a current of (n F) frequency produces two hypothetical rotating fields—the one useful, and of (n + 1) F, the other idle, and of (n − 1) F frequency. By aid of condensers, the latter component can be suppressed so far as concerns its action on the windings, but it inevitably sets up supplementary losses in the iron. In Goldschmidt's alternator, this difficulty is overcome by using only a single alternator, between the stator and rotor windings of which energy is "reflected" to and fro with continuous increase in frequency. Combinations of condensers and inductances permit the selection of the desired high frequency, and all components of lower frequency neutralise each other, thus securing comparatively high overall efficiency, and comparatively large output at the desired frequency.

Referring to fig. 2, the alternator is excited by D.C., which circulates in the circuit B D S of the stator, and generates a current of frequency F in the rotor circuit R C_3, C_4, D_2; the condenser C_3 is designed to annul the inductance of the rotor, and D_2 and C_4 are tuned to the frequency F, and thus constitute a short-circuit path for currents of this frequency. The heavy current of F frequency thus obtained produces a field of frequency 2 F, and induces a current of corresponding frequency in the stator circuit S C_1 D_1 C_2, where C_1 annuls the stator inductance, and D_1 C_2 are in resonance at 2 F cycles. Thence is produced a current of frequency 3 F in the winding R C_3 C_5, which is designed to offer negligible impedance to currents of this frequency. By yet another reaction between the rotor and stator, current of 4 F is generated in the latter, and circulates in the circuit formed by S, the antenna and earth, which circuit is tuned to the frequency 4 F. The circuit D_1 C_2, which acts as a short-circuit to currents of frequency 2 F, presents high impedance to currents of frequency 4 F.

Although the Goldschmidt alternator contains only single-phase windings, it behaves like a series of alternators in cascade, all being polyphase except the last one. Thus the single-phase current of frequency (n F) produces component fields of frequency (n − 1) F and (n + 1) F, which may be considered as belonging respectively to polyphase alternators of lower and higher frequency. Since the efficiency decreases with increase in the number of "filter" circuits, only four of the latter are actually used, hence the initial frequency F must be high.

Several alternators of this type have been built by Lorenz, and one was shown at the Radio-Conference in London (June, 1912). This machine, which furnished current at 60 kcy. (corresponding to a 5,000-m. wave), employed an initial frequency of 15 kcy., and ran at a peripheral velocity of nearly 500 ft. per sec. At first ball bearings were used, but subsequently ordinary bearings with ring lubrication were employed. The condensers were of mica, and the inductances were of stranded insulated wire wound as flat spirals, and oil-immersed. The output claimed was 9 KW. at 60 kcy., and 12 KW. at 30 kcy.; the efficiency 80 per cent. As to the accuracy of the latter figure there appears some doubt; windage losses must

be high, and unless special ammeters* are used to measure currents of such frequency, 30 per cent. error may easily arise. All high-frequency test data must be accepted with extreme reserve unless the instruments used are specified.

The Lorenz Co. has under construction four 150-KW. Goldschmidt alternators running at 8,000 R.P.M., and having 1 mm. gap.

As mentioned above, the last circuit of a Goldschmidt machine operates as a one-phase alternator, a fact which somewhat diminishes its efficiency, and to avoid this defect, Latour has devised a machine in which the rotor winding is single and the stator winding two-phase (fig. 3). The stator phases in series act as a single-phase circuit for the intermediate frequencies, but for the frequency utilised there are superposed on the one-phase output, two-phase currents which respectively lag and lead 90°, and which produce in the stator a field rotating oppositely to the rotor and exactly annulling the parasitic field due to the one-phase current utilised.

Despite the special difficulties encountered in high-frequency polyphase alternators, Bethenod has devised a system in which four two-phase alternators of the induction type are mounted in cascade with their windings crossed as explained above. In these machines, the laminations are 0·05 mm. thick†; each machine has 240 rotor and stator slots (width 0·25 cm.). The gap = 0·3 mm.; internal diam. of stator, 38 cm.; speed, 6,000 R.P.M.; initial frequency 6 kcy., final 24 kcy.

In order to utilise both phases of generation, two suitably adjusted aerials might be used, but this expedient is costly, and a single aerial can be made to serve by adopting the arrangement shown in fig. 4. One of the phases is connected to the aerial, the secondary of a Tesla coil, an inductance and a condenser; the other is connected to the primary of the Tesla coil, an inductance and a condenser. The condensers are adjusted to annul the inductance of the windings, and by adjusting the coupling of the Tesla coils, the load can be made equal in each phase.

To avoid the necessity for a "ticker" in the reception of undamped waves, Goldschmidt and Bethenod use not D.C. but A.C. of musical frequency to excite the primary windings of their machines. The amplitude of the undamped waves is thus varied periodically and in the receiving telephone a musical note is heard corresponding to the frequency of the alternator exciting the transmitting alternator.

It may be possible to realise high-frequency alternators operating on quite a different principle. If a series wound D.C. dynamo (the field cores of which are far from being saturated) is connected to an oscillating circuit, the latter becomes the seat of oscillations of period $T = 2\pi\sqrt{LC}$ (L = total inductance; C = capacity). The frequency obtained is independent of speed variations in the dynamo, and Rudenberg has shown that the apparatus may be given a form closely resembling an A.C. commutator motor, by closing the armature circuit on the short-circuited brushes and placing in series the inductance, capacity and the field coils. In order, however, to produce undamped oscillations, the resistance of the circuit must be less than a certain limit depending on the characteristics of the machine. That it may be so, the laminations must be very thin, and eddy losses in the commutator must be reduced as far as possible. The self-induction of the field coils being always considerable, it is difficult to attain high frequencies.

It is reported that, during 1912, Arco built an alternator capable of furnishing large output at 120 kcy., but little information is yet to hand concerning this machine. The principle employed is said to be the cascade connection of a number of static frequency transformers depending on the asymmetric magnetisation of iron. The theory of such apparatus was developed some years ago by M. Joly, and its construction and operation were recently described in these columns (see ELEC. REV., August 29th, 1913). The primaries of two transformers are connected in series, the secondaries in opposition and D.C. exciting coils are added, the M.M.F. of which adds to the primary alternating M.M.F. in one transformer and opposes that in the second transformer. The E.M.F.'s induced in the secondary winding contain even harmonics, which add, and odd harmonics which cancel. A suitable capacity in the exciting circuit, resonated for the first even harmonic with the inductance of the secondary, raises the efficiency of the apparatus to a satisfactory value.

Utilisation of High-Frequency Alternators.—Certain of the alternators described above will yield current of 100 kcy. frequency, but the realisation of these machines appears to have been a veritable *tour de force*, so that satisfactory operation at these frequencies in industrial service can hardly be anticipated.‡ There is no doubt, however, that 10 to 30-kcy. alternators of considerable capacity and high efficiency can now be built, and we can profitably consider what part such machines may play in long-distance radio-telegraphy and radio-telephony.

Radio-Telegraphy.—Wave-lengths of 3 to 6 km. have, so far, been employed for long-distance work, and long experience seems to justify the opinion expressed by Poincaré, that long-distance transmission is only practicable by the use of long wave-lengths.

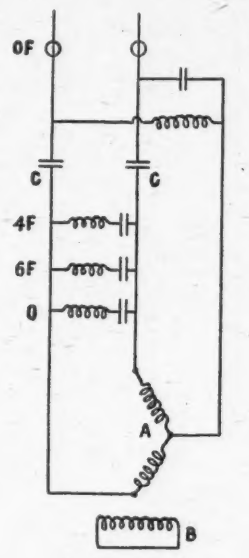


FIG. 3.

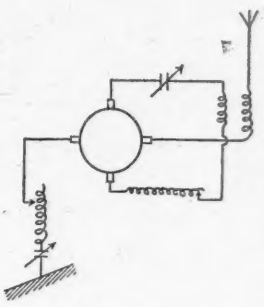


FIG. 4.

Certain authorities have stated that frequencies so low as 10 kcy. (30-km. wave) could be employed for radio-telegraphy, but hitherto all tests with undamped waves have been made with comparatively short wave-lengths (less than 2 km.), and the radiations employed have generally been produced by Poulsen or Moretti arcs, the unstable operation of which has done much to discredit transmission by sustained waves.

Count Arco recently compared undamped waves of 1·75 km. length (produced by an alternator) with damped waves provided by a system having 0·05 decrement, and producing 1,000 wave trains per second. No appreciable difference in reception was observed. On the other hand, it was easier to receive damped waves emitted by sparks of musical frequency, since these differentiated themselves better than undamped waves from parasitic oscillations. Probably, however, this distinction would disappear, or be reversed, were the alternator excited by high-frequency A.C.

Contradictory to these results, we find those reported by the Federal Co., who have established communication between San Francisco and Honolulu, using Poulsen sustained oscillations. Communication was effected over 3,200 km. by night, using a 30-KW. arc, but was impossible using a spark fed by a 60 KW. alternator. The wave length employed was 4 km. The aerial current was only half as great using sustained oscillations as when using the spark system, but the energy received at 1,600 km. was equal in both cases.

To some extent the contradictory results reported during recent years are doubtless explained by the fact that investigators have not always been impartial, and it cannot be disguised that recent progress in spark systems has reduced the interest attaching to the generation of sustained oscillations for wireless telegraphy work. By theoretical considerations, Eccles reaches the conclusion that radiating equal energy, the energy received where the latest spark systems of transmission are employed is 90 per cent. of the energy received using sustained oscillations.

Under these circumstances, the efficiency of high-frequency alternators becomes a crucial factor, and, that it may be high, low-frequency long waves are desirable. The outstanding advantage of alternators lies in the possibility of radiating greater power than has hitherto been available at high frequency. Obviously a great part of the benefit anticipated from the use of sustained waves is sacrificed if the alternator frequency be unconstant, hence the speed at which the machine is driven must be constant within 0·25 per cent. Finally, it must not be overlooked that the construction of suitable antennæ is a matter inseparably connected with the efficient utilisation of sustained oscillations.

Radio-Telephony has not yet attained commercial success, but there is little doubt that satisfactory communication by this means will involve the utilisation of sustained oscillations of frequency exceeding 15 or 20 kcy., and it is probably in this field that high-frequency alternators will find their chief application. In 1907, Fessenden, using one of his own alternators, effected radio-telephonic communication between Brant Rock and New York (190 miles), and a 100-kcy. Alexanderson alternator has been used in similar tests. The relative failure to date of radio-telephony is not due to the impossibility of generating suitable sustained oscillations, but to the lack of a suitable microphone. The day on which the latter becomes available will see the birth of commercial radio-telephony.

* The first industrial high-frequency ammeter was invented by Broca in 1908, since when Hartmann & Braun have built an instrument depending on practically the same principle.

† The success of recent high-frequency alternators is largely attributable to that progress in metallurgy which has rendered available plates of silicon steel sufficiently thin to reduce iron losses to a permissible value. The fragility of these plates makes manufacturing costs high.

‡ Since these notes were written, the Commission appointed to consider the technical features of the Imperial wireless chain scheme has expressed the opinion that although the future belongs to high-frequency alternators, no machines submitted to it appeared suitable for commercial traffic. Vessels in the German Navy are provided with apparatus for generating damped waves, as well as with Poulsen sustained oscillation apparatus. In military applications, sustained oscillations offer the important advantages that signals can only be received in stations provided with tickers, and communication can be established under such conditions that blocking by an enemy's signal becomes very difficult.

APPARATUS ON HIRE.

By T. C. PARSONS.

It is maintained by some people that electrical apparatus should not be hired out by a municipal authority, but that such work should be left to private traders. The objection to this from the municipal engineer's point of view is twofold :—

1. Very few private traders are willing to hire out apparatus.

2. Firms other than electric supply authorities carrying out a hiring scheme must make their profit out of the hiring scheme itself, and cannot therefore give consumers the same advantages as they would obtain from a supply authority, who only need to cover expenses. If the supply authority are a private company, no exception is taken to their hiring out any apparatus they wish on any terms they choose, and if it is right for a municipality to own a supply undertaking, it is illogical to object to their extending their business in any way that would be considered perfectly legitimate for a private company, if it can be carried out by them in an equally satisfactory manner as by a private firm.

Motors.—Advantages of Hiring Scheme.

1. Enables small firms to adopt electric driving without incurring much initial outlay.

2. Increased reliability, due to supervision of the supply authorities, is a great inducement to many firms to hire instead of purchasing, especially in the case of consumers who are not engineers and who have not got an engineering department. The authorities' inspectors give frequent and efficient attention to the hired motors, instruct the hirers how to clean and look after the machines, *and see that it is done regularly*, and expensive repairs are often prevented in this way.

When the writer was burgh electrical engineer of Govan (which is now incorporated in the Glasgow municipal area), there were several cases where people discarded their own motors in order to hire from the Corporation. In one case a firm which had all their machinery electrically driven, had a breakdown with one of their motors. They hired one from the Corporation to tide them over their difficulties, but when their own machine was repaired they sold it and kept the Corporation motor, and shortly after sold both their other motors and hired three in their place from the Corporation (although their installation was only between three and four years old), because they felt that they had much greater security when the Corporation were maintaining the motors.

Another advantage is that the Corporation keep a stock of spares, and in the event of anything going wrong with a hired motor, it can be quickly repaired, or, if necessary, a spare armature, field coil or a complete spare motor put in with the delay of a few hours only.

3. Many people are not convinced that electric driving will suit their particular case, and will not, therefore lay out any capital, but if the supply authority will rent motors, they are prepared to give them a trial.

There were several instances of this sort in Govan, where firms tried electric driving with hired motors, found it satisfactory, and purchased for themselves electrical equipment for their whole works. One firm that started in this way ultimately installed over 1,200 H.P.

A point that appeals to many people is that if the supply authority have sufficient faith in electric driving to be prepared to find the necessary capital, then there must be a considerable chance that electric driving will be suitable in their case.

4. The supply authorities have at their command data with regard to electric driving for all classes of machinery

TABLE I.—Particulars of Motor-hiring Department of Govan Corporation.

Year.	No. of motors installed.	H.P. of motors installed.	Net capital.*	Total depreciation as at May 15th.	Percentage of capital.	Rent received for year.	Percentage of capital.	Attendance.	Repairs.	Total attendance and repairs.	Percentage of capital.	Total attendance, repairs, depreciation, interest and sinking fund.	Percentage of capital.
			£ s. d.	£ s. d.		£ s. d.		£ s. d.	£ s. d.	£ s. d.		£ s. d.	
1904†	2	40	188 6 11	—	—	13 17 0	14·7	—	—	—	—	5 3 6	5·5
1905	17	230	1,075 15 3	44 9 7	4·13	97 1 9	9 0	0 16 0	8 11 3	9 7 3	·87	110 8 10	10·2
1906	42	454	2,549 2 5	203 1 4	8 0	242 0 4	9·5	21 2 2	17 1 2	38 3 4	1·5	325 15 1	12·75
1907	55	586·75	2,991 8 1	451 11 10	15·1	422 5 6	14·1	34 3 7	10 8 5	44 12 0	1·49	441 17 1	14·7
1908	56	621·75	3,597 2 9	550 16 6	15 3	427 7 7	11·9	48 9 4	51 10 10	100 0 2	2·78	405 6 10	11·3
1909	66	759·15	3,900 2 4	723 2 5	18 5	541 2 0	13·85	67 12 5	33 18 5	101 10 10	2·59	448 6 9	11·5
1910	68	745	3,885 12 3	862 0 3	22·2	574 0 1	14·75	55 15 5	51 15 3	107 10 8	2·76	459 19 9	11·8
1911	72	788·6	4,084 8 2	1,055 10 10	25·8	626 6 11	15·3	58 15 11	121 9 2	180 5 1	4·4	648 18 2	15·9
1912	104	1,056	4,609 2 4	1,483 9 1	32·2	731 6 0	15 9	83 10 10	42 19 6	126 10 4	2·74	727 7 10	15 8

* Gross capital, less cost price of motors sold to hirers. † Six months only.

TABLE II.—Particulars of Motor-Hiring Schemes in 18 Towns.

Town.	Years scheme in operation.	No. of motors, 1912.	H.P. of motors, 1912.	Capital, 1912.	Attendance and repairs as % of capital, 1912.	Av. attend. and repairs as % of capital since scheme started.	Depreciation, per cent.	Rent. Simple hire.	Rent. Hire-purchase.	Remarks.
					%	%	%	%	%	
1	10	59	125	745	4½*	4½—5*	10	20—30	See Note A	*Percentage on depreciated value.
2	10	62	250	1,539	·34†	·05†	10	20	50	†Attendance not booked.
3	10	362	1,555	15,500‡	—	—	10	—	—	‡£6,000 taken out of revenue.
4	12	388	2,156	15,226	1·88	—	10	10	—	
5	10	337	1,045	5,000	9	9	12½	14	—	
6	10	70§	670	3,756	4½	4½	See Note B	12½	—	§308 motors, totalling 2,552 H.P., purchased by hirers.
7	10	66	262	2,190	—	—	10	14	—	
8	6	28	188½	1,155	5·92	7·23	10	16·9	—	
9	6	35	432½	1,800‖	2·13	2·0	—	15	—	‖Includes wiring.
10	9	50	369	2,473¶	6·0	5·0	7½	16	—	¶Written down to £1,271.
11	8	104	1,056	4,609	2·74	2·39	6·08	13·04	—	
12	9	615	2,894	5,454	3·4	3·15**	See Note C	14	—	**Average for last three years.
13	10	98	675	2,236	—	—	12½	—	—	
14	9	79	354	3,138	4·1	3·63	—	20	20††	††Maint. not included in hire-p'rch'se.
15	10	90	500	3,500	4·0	4·0	10	16—20	30‡‡	‡‡5 years' purchase.
16	10	126	954	8,146	4·6	—	—	10	—	
17	10	120	666	2,993	2·0	—	10	12	—	
18	12	149 (hire) 82 (hire-p'ch.)	1,006 1,129½	6,772	3·0	3·0	9	—	—	

A.—If hirer wishes to purchase, 15 % is added to cost price, and from figure so obtained one-third of total rent paid is deducted.
B.—£2,675 repaid to date. C.—Life of motor taken at 23 years.

and can advise as to the most suitable type and power of motor, and if in any particular case a mistake is made and too small a motor put in, there is no difficulty about taking it into stock and installing a machine exactly suitable.

MOTOR VALUATION BOOK.
GOVAN CORPORATION ELECTRICITY DEPARTMENT.

MOTOR VALUATION.

Motor. H.P..... Speed..... Voltage ..... Corporation No .....
Maker..... Maker's No..... Price .....
Rails price ..... Date received .....
Starter. Maker..... Maker's No..... Corporation No. .....
Price ..... Date received .....
D.P. Switch. Size ....., amps. Maker..... Price .....
Fuses. Size ..... amps. Maker..... Price .....
Total Value of Equipment £...s...d. Rent per Annum £...s...d.

INSTALLED AT

Name.	Address.	Date sent out.	Date brought in.

AMOUNT OF RENT RECEIVED.

Year end'g	£	s.	d.	Year end'g	£	s.	d.	Year end'g	£	s.	d.	Year end'g	£	s.	d.

TOTAL VALUE OF EQUIPMENT.

Year end'g	£	s.	d.	Year end'g	£	s.	d.	Year end'g	£	s.	d.	Year end'g	£	s.	d.

MOTOR REPAIRS.

Date.	Nature of repair.	£	s.	d.

5. The Corporation supply authority having a stock of motors of various sizes are in a position to put in motors at a few hours' notice in the case of a breakdown of steam or gas plant, and in such a case if the firm owning the plant which failed is not already a consumer, it will probably become one permanently.

Hiring Department.

The success of a motor hiring department depends on getting first-class apparatus and in giving efficient attention. The rental will depend on the capital cost of the motor, and the better the machine the less liable it will be to require expensive repairs.

It is desirable to keep to one or two makes of motors only, to keep down the stock of spares and to increase interchangeability.

Low-priced starters, especially in the higher horse-powers, are a fruitful source of trouble, and, in the end, far more expensive than first-class articles.

With regard to attendance, all motors should be inspected once a fortnight, and in special cases such as bakers and other works where there is much dust flying about, once a week. Frequent inspection materially reduces the repair bill. In the case of the Govan undertaking the average cost of maintenance and repairs taken over a period of eight years was 2·39 per cent. of the capital outlay, the highest being 4·4 per cent. in one year when it happened that three fairly large armatures had to be rewound, and the lowest ·87 per cent. Particulars of these charges incurred in the Govan undertaking are given in Table I, of which a short explanation may be given here.

For the first 18 months, when there were only a few motors hired out, there was no special attendant, but the inspections were made by the mains superintendent as he went round his district, which accounts for the small amount allocated to attendance for that period. After that period, however, a man was specially told off for that and other work, and all his time carefully allocated. Nothing, however, has been allowed for general supervision by the mains superintendent.

The amount allowed for depreciation is heavy, due to the fact that the prices of motors have been steadily falling, owing to the general cheapening of manufacture, but chiefly to the introduction of fan blades, which allow the output of a given size of machine to be increased by about 25 per cent., and consequently the values of motors without fan blades had to be written down.

Taking the sum for the whole period since hiring was started, the rents received were £3,675 7s. 2d., and the total expenses (maintenance, depreciation, interest and sinking fund) were £3,573 3s. 10d., giving a credit balance of £102 3s. 4d. The average rent was 13·04 per cent., and the average depreciation 6·08 per cent., which was really too large. The average rent of 13·04 per cent., as is mentioned in Table II, is the average of the rent received for eight years, and is a percentage of the total capital including spare motors.

Table II gives figures obtained from 17 other towns in addition to Govan.

Rental Charges.

Rent should in all cases be payable in advance.

Simple Hire.—Allow for interest, sinking fund, attendance, repairs and sundries (office charges, capital charges on stock motors, &c.).

It is customary in some undertakings to charge the hirer with all repairs, but in the writer's opinion, this should be included in the rent, the authority being protected against wilful damage or neglect by a special clause in the agreement. This is a perfectly safe course, and in nine years the total charge that had to be made against hirers on this account by the Govan Corporation amounted to a little over £5.

Taking the life of a motor at 20 years, and assuming the loan repaid in that period, the sinking fund—based on allocation of a sum which, improved at 3 per cent., will equal the loan in 20 years—will be 3·72 per cent.; the interest, 3·5 per cent.; attendance and repairs, 3·5 per cent.; and for sundries allow 3·28 per cent. The total charges will then be :—

Interest	3·5 %
Sinking fund	3·72 %
Repairs, &c.	3·5 %
Sundries	3·28 %
Total	14·00 %

It will not be necessary to allow anything for depreciation, because the loan is repaid well within the life of the motor. Sir W. Preece, in his report some years ago to the Bristol Corporation on the machinery at the electricity station, gave it as his opinion that the useful life of a motor was 25 years, with a residual value of 9 per cent.

When it is not desired to make a profit out of the actual hiring, but simply to cover expenses, 14 per cent. is a perfectly safe figure; and when a large number of motors are installed by one firm, a considerably lower figure might be charged.

Hire-Purchase.

During the term of hire-purchase, the supply authority attend to and maintain the motors in exactly the same way as for simple hire, and for this and for the use of the capital an addition of about 8 per cent. per annum should be made to the price of the motor. The charges would then be :—

Years to complete purchase.	Number of quarterly payments.	Percentage of capital cost for each quarterly payment.
1	4	27 %
2	8	14·5 %
3	12	10·4 %
4	16	8·25 %
5	20	7·0 %

Stock Motors.

If motors are purchased from one or two firms only it will not be necessary to keep a very large stock of motors, one of each size usually being sufficient.

During the nine years that the Govan undertaking hired out motors, 146 motors were purchased and the stock rarely amounted to more than eight motors, but no difficulty was ever experienced with regard to spares. A good many

pulleys of various diameters were stocked, so that one motor would frequently serve as a spare for several speeds of motors of the same size frame, the armature of the stock motor with a different size pulley being put into the fields of a defective motor temporarily, whilst its own armature was being repaired. When the field coils failed it was usually the outer layer only and was easily repaired at the station in an hour or two.

Special Books, &c.

Motor Valuation Book.—This book (suggested form of which is appended) is a very useful one as it gives at a glance the complete history and value of the motor, where it has been installed and the cost of repairs.

Although the life of the auxiliary apparatus is not as long as that of the motor, it would introduce unnecessary complication to have separate valuation books for the switchgear.

The switchgear is purchased in the first place out of capital and maintained out of revenue, and if any part of it fails beyond repair a new article is purchased out of revenue, given the same number as the apparatus that failed and put in its place without altering the amount entered as the total value of the equipment.

Each year the value of the equipment is written down by the amount of the sinking fund, which will increase each year according to the following table.

This is not depreciation as separate from the sinking fund, but gives the value of the machine at which it can be sold at any time without loss to the supply authority, should the hirer who has taken the motor on simple hire, wish to purchase it at any time.

As it is assumed that the sinking fund is improved at 3 per cent., the amount written off will increase each year :—

		Percentage of first cost to which at the end of the year the equipment will be written down.
1st year	96·28	
2nd „	92·45	
3rd „	88·4	
4th „	84·33	
5th „	80·14	
6th „	75·83	
7th „	71·38	
8th „	66·81	
9th „	62·1	
10th „	57·24	
11th „	52·24	
12th „	47·1	
13th „	41·8	
14th „	36·34	
15th „	30·71	
16th „	24·92	
17th „	18·95	
18th „	12·8	
19th „	6·47	
20th „	00	

In allocating the accounts at the end of the year the procedure would be to deduct from the rents received, the charges for interest, sinking fund, attendance, repairs and general charges, and place the balance to a motor reserve fund.

On the page set apart for each motor in the motor valuation book is entered a short note of the nature of repairs, date and amount. Small repairs that the motor inspector does by himself, and the cost of which is chiefly his time, should not be entered, but regarded as attendance.

Hirer's Register.—For a small undertaking a hirer's register is hardly necessary, as the Motor Valuation Book practically answers the purpose, but where there are many motors let out on hire, probably the best form of register would be on the card index or loose-leaf principle, the card or loose leaf being ruled as follows :—

Name .....

Address .....

Corp. No.	H.P.	Speed.	Date installed.	Date removed.	Rent per annum.			Rent per quarter.	
					Rails.	Motor.	Total.	Rails.	Motor.

Such a system is very convenient when sending out the accounts for hire.

(To be continued.)

REVIEWS.

Introductory Electricity and Magnetism. By C. W. Hansel, B.Sc. London : W. Heinemann. Price 2s. 6d. net.

This book forms one of Mr. Heinemann's series of Science Manuals. These manuals are attractively produced, well bound and printed, and the material in this particular book must be said to reach a fair standard of excellence. But it is difficult to understand exactly the *raison d'être* of this series ; they will probably become widely used in the grammar schools up and down the country, but, after all, it must be admitted that the statement that a book is intended to be "a complete first course in electricity and magnetism" is delightfully vague and unsatisfying.

Mr. Hansel, however, appears to have a tolerably clear idea of the people for whom he is writing, and he has produced a very good little book. The subject is treated very clearly and thoroughly, and the illustrations are wisely chosen and well drawn. He has perhaps erred on the side of extravagance in his variations in size of type, but this is not a serious fault. The experimental side of the work is emphasised, but not to the exclusion of theory, and on the whole the book should serve to tide the average student well over the matriculation standard and give him a sound knowledge of the fundamental principles of electrical science.

Electricity in Mining. By Siemens Bros. Dynamo Works, Ltd., with plans and illustrations. London : Chas. Griffin & Co. Price 10s. 6d. net.

It has long been known to technical students that correct and complete descriptions of the design (and often the theory) of instruments are more often found in catalogues than in text-books, and it has become no uncommon practice among physics students to consult the elaborate catalogues issued by some of the best instrument firms for exact and up-to-date information on such subjects, for example, as pyrometry and electrical measuring instruments. It has, however, been left to Messrs. Siemens and Griffin to compile a glorified catalogue, and deliberately to publish it in the form of a text-book.

But while it is necessary to explain the peculiar status of the book before us in order to remove any misconception as to its purpose, we would also point out that there appears to be no weighty reason why ambitious advertising and the propagation of reliable and accurate information should not go hand in hand, and, indeed, "Electricity on Mining" would serve as an excellent example of the possibilities of this novel idea.

The book is extremely well produced, the printing and binding being good and the illustrations excellent, and there is very little of importance in the electrical working of mines that has not received fairly complete treatment in its pages.

It is, of course, unnecessary to enlarge upon the unique experience of the Siemens Company which renders them so competent to write with authority on electrical mining machinery, and the mere fact that they are not specialists on one branch only, but on all branches of their profession, frees their book from any stigma of one-sidedness which might attach to similar publications emanating from less renowned companies.

"Electricity in Mining" gives exhaustive accounts of all the most important mining concerns in which electrical plant has been set up by any of the numerous Siemens companies scattered over the earth ; and when the names of these concerns are mentioned, it is abundantly evident that the plant described includes some of the largest and most modern mining machinery in the world. In Great Britain Messrs. Siemens have equipped the Powell-Duffryn Co., the Cambrian Collieries, Ltd., and many of the supply companies in the Newcastle-on-Tyne district. Abroad their installations include 32,000 kw. at the Gelsenkirchen Bergwerks, 2,000 kw. at Rio Tinto Copper Mines, and supplies for the Baku Oil Field and the Chile Nitre Beds. Detailed descriptions and plans of all these distribution systems are given, together with lists of the power users and the uses to which it is put.

The first part of the book treats of power stations of all types; steam engines, steam turbines, gas engines, Diesel engines and water power have all come within the purview of Messrs. Siemens's experience, and illustrated examples with comparisons of efficiency and local conditions are given of all these systems. In all modern supply stations for long-distance transmission, high-pressure generators are employed, and three-phase generators working at about fifty cycles, 2,000 to 4000 volts, appear to be the most usual types.

Transmission and transformers are treated very fully, and examples are given of installations ranging from quite low pressure up to 70,000 and 100,000 volts. Winding, hauling, sinking and pumping are also fully treated, and there is an illuminating chapter on haulage by electric locomotives. The subject of electrical rock-drilling by percussion and rotary drills is also given some attention, while shot-firing and mine illumination are touched upon, but not treated fully. There is a complete index to the contents, and a list of Siemens companies is printed at the end of the book.

As a catalogue of Messrs. Siemens's electric mining installations, this publication must be given unstinted praise; as a text-book of mining electricity, the practical engineer will undoubtedly find it of considerable value, but he will probably consider that half a guinea is a high fee for a book that reminds him so much of a catalogue.

The National Form of Building Contract (annotated and explained), together with suggested Alterations and Amendments to meet particular cases. By W. Valentine Ball, M.A. (Cantab.), Barrister-at-Law, and W. H. Hope, Legal Adviser to the Northern Counties Federation of Building Trade Employers. London: The Local Government Journal Publishing Offices. Price 6s.

This book attempts to provide contractors and architects with a guide to the Agreement and Schedule of Conditions of a Building Contract, published under the sanction of the Royal Institute of British Architects, and agreed by the Institute of Builders and the National Federation of Building Trade Employers of Great Britain and Ireland.

This agreement, in one of its two usual forms, is in very extended and—on the whole—satisfactory use. Its peculiar features have to a large extent received interpretation in the Law Courts. The agreement is either made out in the form of a lump-sum contract in which the total sum to be paid is stated in an unqualified single lump sum, or what is termed a QB/c contract, in which a detailed bill of quantities is embodied in the contract and the lump sum, if given, is qualified by reference to the bill of quantities. The authors are of opinion that on the whole the QB/c form of contract is preferable from the point of view of both employer and contractor.

The book takes the clauses of the agreement seriatim, and details notes of legal interpretations which have been given to them and also suggestions as to their correct interpretation.

The authors point out the risk which all parties run if they alter such a well-known and carefully-constructed document, by modifications of their own. They give as a particular instance of this a contract made in 1906 between Messrs. John Barker & Co., Ltd., and the Hurlingham Club to do certain work at the Club's Fulham premises. In the contract a clause was added to the effect that "No extras whatever will be allowed, except upon a written blue order signed by the employer and the architect, the cost being first ascertained and approved by the Committee." In the end there was a sum of about £1,470 in dispute, and in October, 1912, the case was heard in the King's Bench Division. By a curious printer's error this date is given in one part of the book as October, 1913. After hearing all sides, the three Judges trying the case agreed that the new clause referred to entirely new work and that alone, and that it did not govern the omissions and extras which were included in the original contract.

The book is very useful, as in addition to its commentary upon the duties and responsibilities of employers, architects, clerks of works, contractors and sub-contractors, it points out what care should be taken in pricing out a bill of quantities and in signing a contract drawn up in this form.

To the uninitiated it often seems that the phraseology and detail of a building contract is obsolete and unnecessary, but the authors take pains to point out that there is reason in most of the apparent madness. They are both experts in building law, and they imply, rather than directly state, that the usefulness of the present procedure is proved not by the isolated cases in which disagreements take place, and recourse to the Courts becomes necessary, but by the many, many cases of complicated contracts which are pleasantly and successfully carried to completion under its auspices. It is well to point out that in these conditions the right of the contractor to arbitration by an independent arbitrator is carefully maintained. There are a few unimportant exceptions, such as regards decisions respecting discrepancies in drawings, demands for dismissal of unacceptable workmen, questions as to opening up finished work, and the removal and non-use of improper materials. While the conditions of building and engineering work are so different that the subject matter of the book has little direct interest for the engineer, we strongly recommend all engineering contractors whose work involves questions of buildings, sewers, conduits or foundations, to read this book and afterwards keep it for reference on their bookshelves. It will far more than repay its cost.

Dynamo Laboratory Outlines for Students in Electrical Engineering. By J. F. Wilson, B.S. London: Hill Publishing Co., Ltd. Price 4s. 2d. net.

This book is interesting in that it provides us with a summary of the laboratory work in electrical engineering in the schools and colleges of the United States. In his preface the author explains that the preparation of these outlines was undertaken with the idea of supplying a laboratory manual of limited scope and cost, yet containing such material as would meet the requirements of electrical engineering courses generally. To this end a study was made of all available information regarding a large number of American Universities and Technical Schools, and, although it was found impossible to include every experiment listed by these schools, the substance of every experiment having general engineering interest has been incorporated in this volume.

The book is divided into two approximately equal sections, one dealing with direct currents and the other with alternating currents, the whole being preceded by some short notes concerning resuscitation from electric shock and general laboratory instructions.

The outlines consist of short but explicit instructions regarding the performance of each experiment, and conclude with a list of well chosen questions, both on the theory and on the practical operation of the apparatus studied. The author appears to have steered a middle course between the heuristic method on the one hand, and the "spoon feeding" method on the other, and he is quite right in insisting upon a proper outline of instructions for experimenting, as well as a proper use of the faculties of observation by the student. In an apt illustration he points out that the tourist visiting Colorado saves time and gains more information by employing a competent guide than by starting out alone to "discover" Pike's Peak; the tourist, however, gains little information by simply following the guide—he must use his faculties of observation.

Another good point about the book is that it asks the student as a preliminary to experimenting on electric machines to "study the electrical and mechanical construction" of the various types of dynamo, to draw diagrams of the electric circuits and to make sketches of the important parts. This preliminary survey is frequently omitted from electrical engineering courses, and a student often finds that after studying one particular machine for some days, he is still hopelessly incompetent to express an opinion as to whether the next machine is of the shunt, series or compound-wound type.

No attempt has been made to explain the theory of the experiments, but the student is referred to text-books at the end of each experiment. It would, however, have made the

book more useful if definitions of "characteristic," "external characteristic," "regulation," &c., had been given in the text instead of being merely referred to in the questions at the end of the experiment. The references are, of course, mainly to American text-books, and consequently the book's usefulness in English colleges is badly crippled.

The sections on "Stray Power" and "Magnetic Leakage" are especially useful and suggestive.

Part II—on alternating currents—includes a far larger number of experiments than any English college course can boast, probably owing to the more extensive use of A.C. transmission in the States. The same method is adopted as in Part I, and some useful sections on Transformers, Converters, and Rectifiers are included.

The author claims that the results of these outlines in the University of Michigan have been most satisfactory, and we can imagine that some such laboratory book would be welcomed in many of our own electrical engineering laboratories; but perhaps Mr. Wilson's outlines are a little too American for English colleges to accept them *en bloc*.

NEW PATENTS APPLIED FOR, 1913.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

19,205. "Method of electrically-operating railway signals." R. Meakin. August 25th.

19,219. "Multiple way insulating sleeve as separator between conductors on cable joints." R. B. Mitchell and F. J. Cooper. August 25th.

19,220. "Telephone call recorders." D. J. McGauran. August 25th. (Complete.)

19,229. "Electrolytes for the electro-deposition of zinc." S. O. Cowper-Coles. August 25th.

19,249. "Selecting apparatus for telephones." H. Hull. (Convention date, August 26th, 1912, United States.) August 25th. (Complete.)

19,268. "Electric clocks." T. Rushton. (Addition to 10,100, 1913.) August 25th.

19,270. "Damping device for meters or like delicate instruments." E. F. C. Seignol. (Convention date, September 6th, 1912, France.) August 25th. (Complete.)

19,271. "Electric devices for calling any one of several stations connected to the same line." Siemens & Halske Akt. Ges. (Convention date, August 24th, 1912, Germany.) August 25th. (Complete.)

19,272. "Method of determining the amount of ozone in ozonised gases or gas mixtures." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts Ges., Germany.) August 25th. (Complete.)

19,276. "Wire-drawing apparatus." W. Frese. August 25th. (Complete.)

19,277. "Process and apparatus for the subsequent treatment of drawn or rolled wires." W. Frese. August 25th. (Complete.)

19,305. "Telephone exchange systems." E. R. Corwin. August 26th. (Complete.)

19,313. "Magneto-electric machines." H. C. H. Smyth. August 26th. (Complete.)

19,388. "Electric switches." J. H. Tucker. August 27th.

19,395. "Interchangeable alternating and direct-current electric motor." H. Ashdown and F. H. Robinson. August 27th. (Complete.)

19,421. "Telephone exchange systems." F. R. McBerty. (Divided Application on 25,174/12, November 2nd. Convention date, November 3rd, 1911, United States.) August 27th. (Complete.)

19,442. "Electric incandescent lamps." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 27th.

19,443. "Starting and controlling mechanism for electric motors." British Thomson-Houston Co., Ltd., and R. D. Given. August 27th.

19,444. "Mercury switching devices." H. S. Hatfield. August 28th.

19,445. "Alternator with multiplied frequency." M. Breslauer. August 28th.

19,456. "Construction of rotary baths for the electro-deposition of metals and their alloys." C. Haythorpe. August 26th.

19,478. "Dynamo-electric machinery." A. Koerner. August 28th.

19,496. "Electric rat traps." B. F. Ash. (Convention date, August 28th, 1912, United States.) August 28th. (Complete.)

19,498. "Safety devices for use in electric circuits." C. A. Newell. August 28th.

19,512. "Electric transformers and welding, smelting and like apparatus." R. Mack. August 28th. (Complete.)

19,517. "Polyphase alternating-current commutator motors." E. F. W. Alexanderson. (Convention date, August 28th, 1912, United States.) August 28th. (Complete.)

19,518. "Circuit arrangements for automatic and semi-automatic telephone systems." Siemens & Halske Akt. Ges. (Convention date, August 28th, 1912, Germany.) August 28th. (Complete.)

19,521. "Telephone systems." W. Aitken. (Addition to 16,906/12.) August 28th.

19,524. "Electric starters for internal-combustion engines." E. V. Hartford. August 28th. (Complete.)

19,551. "Electric fuse." W. B. Boyd and J. B. Tannahill. (Addition to 12,273/12.) August 29th. (Complete.)

19,564. "Transformation and distribution of electric currents for lighting, power and other purposes." D. Suchostawer and J. Orchard Oxley. August 29th.

19,588. "Continuous-current transformers." P. M. J. Boucherot. (Convention date, September 18th, 1912, France.) August 29th. (Complete.)

19,592. "Selector switches for telephone systems." Sterling Telephone and Electric Co., Ltd. (Telephonfabrik Akt. Ges. vorm J. Berliner, Germany.) August 29th. (Complete.)

19,603. "Insulative rail joints for railways and the like." B. R. Wills and J. C. Sykes. August 29th.

19,605. "Magneto electric switching devices." H. S. Hatfield August 29th.

19,606. "Galvanic cells and hand lamps." J. C. N. Eastick. August 30th.

19,619. "Electrically-heated cooking and like appliances." Unit Engineering Co., Ltd., and F. A. Brown. (Addition to 759, 1913.) August 30th.

19,640. "Electric railways." A. L. Simon. August 30th.

19,648. "Polyphase current starters." Voigt & Haeffner Akt. Ges. (Convention date, December 23rd, 1912, Germany.) August 30th. (Complete.)

19,650. "Electric relay apparatus." A. Orling and Orling's Telegraph Instruments Syndicate, Ltd. August 30th.

19,654. "Galvanic batteries for pocket lamps." G. Engisch. August 30th.

19,668. "Rectifiers for electric currents." O. W. Richardson. August 30th. (Complete.)

19,669. "Electrolytic recovery of metals from their solutions and apparatus therefor." U. C. Tainton and M. F. L. A. Aymard. August 30th.

19,676. "Tuning apparatus for making and breaking electric circuits." K. F. Richmond. August 30th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1912.

Alarm Devices for Use with Wireless Telegraph Systems. W. H. Shepherd and A. E. McKechnie. 11,479. May 14th.

Electrically-heated Devices. E. C. R. Marks. (Landers, Frary & Clarke.) 15,958. July 8th.

Vapour Electric Devices. British Thomson-Houston Co. (General Electric Co.) 18,371. August 9th.

Wireless Telegraphy and Telephony. J. T. Sibley. 18,422. August 10th.

Electrical Ignition and Starting and Lighting Systems for Internal-combustion Engines. W. E. Lake. (J.B.M. Electric Co.) 18,444. August 10th.

Electric Secondary Clock Alarm. G. Lange. 18,479. August 12th.

Dynamo-electric Machines. Brolt, Ltd., B. Brooks and W. Holt. 18,913. August 19th. (Addition to No. 26,880 of 1910.)

Construction of Heating Elements for Electric Radiators and the Like. C. R. Belling. 19,054. August 20th.

Electrically-heated Cooking Ovens and the Like. H. J. Piper and R. A. Bridgwater. 19,064. August 20th.

Electrical Connections. W. E. Lake. (Soc. Anon. le Carbone.) 20,357. September 6th.

Electric Pendulum and Switch for Controlling Electric Clocks. W. J. Parker. 21,115. September 17th.

Electrically-operated Means for Restoring Equilibrium of Inclined Bodies. J. M. Smits. 21,832. September 25th. (Divided application on No. 15,667 of 1912, August 7th.)

Electric Oil Switches. British Thomson-Houston Co. (Allgemeine Elektricitäts Ges.) 21,867. September 25th.

Railway-control Telephone Systems. J. N. C. Kennedy. 22,131. September 28th.

Electrical Regulators. A. A. Tirrill. 22,419. October 2nd. (October 5th, 1911.)

Regulation of Dynamo-electric Machines. Allgemeine Elektricitäts Ges. 23,372. October 13th. (October 13th, 1911.)

Electric Shade Carrier. A. E. Otway, J. H. Ormrod and W. J. Purdue. 23,520. October 15th.

Means for the Interruption of Electric Circuits. British Westinghouse Electric and Manufacturing Co. (Westinghouse Electric and Manufacturing Co.) 26,809. November 21st.

System of Duplex or Multiplex Wireless Telegraphy or Telephony. S. D. Williams. 28,042. December 5th.

Electrical Potential Regulators. M. Fuss. 28,061. December 5th. (December 6th, 1911. Addition to No. 7,220 of 1911.)

Apparatus for Heating Water or other Liquids Electrically. W. H. Bennett. 28,270. December 7th.

Catoptric Light Apparatus. A. Blondel. 28,297. December 7th.

Electric Switches. P. S. Turner and A. E. Roberts. 30,060. December 31st.

1913.

Telephone Receivers. V. Anderson. 2,507. January 30th. (April 3rd, 1912.)

Telephone Systems. Telephon Apparat Fabrik E. Zwietusch & Co. 2,700. February 1st. (March 15th, 1912.)

Shade Holders for Incandescent Electric and other Lamps. D. G. Saunders, jun. 3,931. February 15th.

Electric Fuses. F. Gruneberg. 6,156. March 12th.

Telegraph and other Signalling and the Like Apparatus. H. O. A. Jensen. 6,292. March 13th. (Divided application on No. 18,985 of 1912, August 19th.)

Electric Warp Stop Motions for Looms. J. Hancq. 7,570. March 31st.

Sealing Terminals and Connections for Electric Cables. F. A. Cortez-Leigh and G. Broughall. 7,996. April 5th.

Manufacture of Electrodes for Arc Lamps. J. Roubal. 10,210. April 30th.

Electric Incandescent Lamps. Allegemeine Elektricitäts-Ges. 14,048. June 17th. (September 18th, 1912.)

Material for Accumulator Cases. W. E. W. Richards. 223. January 3rd.

Storage Battery Plates. W. M. McDougall. 770. January 10th.

Electric Switches. Fried. Krupp Akt.-Ges. 3,835. February 14th. (March 15th, 1912.)

Electricity Meters. J. Elster. 4,847. February 25th.

Transmitters for Wireless Telegraphy. C. Schou. 5,040. February 27th.

Gyroscope Compasses. Hartmann & Braun Akt.-Ges. 6,570. March 17th. (March 18th, 1912. Addition to No. 23,575 of 1910.)

Apparatus for the Manufacture of Insulated Conductors or Coils for Electrical Purposes. Siemens Bros. Dynamo Works. (Siemens Schuckertwerke Ges.) 6,647. March 18th.

Switch Controlling Mechanism for Electric Motors. O. Decker. 8,878. April 15th.

Telephone Relay. F. Majorana. 10,154. April 30th.

Driving Dynamos Attached to Vehicles. C. E. Pehrsson. 16,979. July 24th. (Divided application on No. 18,492 of 1912, August 12th.)